RAILROAD GAZETTE

SATURDAY, DECEMBER 30, 1871.

## THEN AND NOW.

Last week we published an engraving of the standard thirty-ton locomotive now built by the Baldwin Locomotive Works in Philadelphia. This week we give engravings of the first locomotive built in this country. This was constructed by Mr. Peter Cooper, in the summer of the year 1829, for the Baltimore & Ohio Railroad. Of this engine Mr. John H. B. Latrobe, of Baltimore, who witnessed its trial, gave the following description in a lecture before the Maryland Institute in 1868:

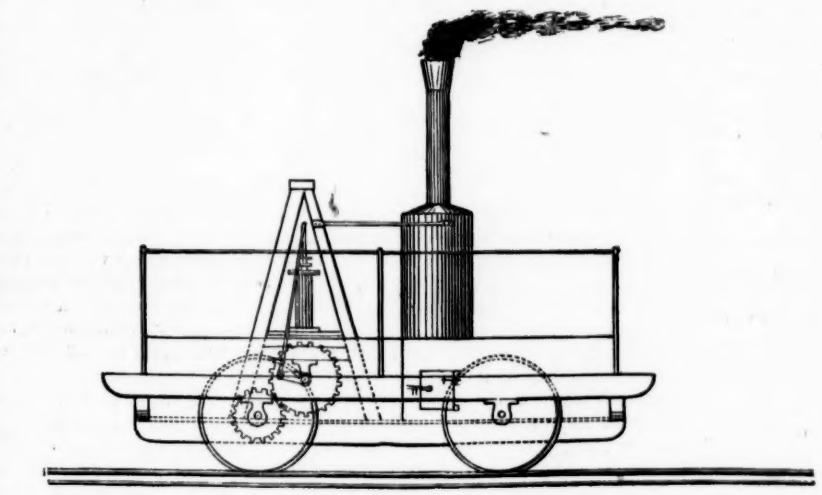
"Mr. Cooper was satisfied that steam might be adapted to the curved roads which he saw would be built in the United States; and he came to Baltimore, which then possessed the only one on which he could experiment to vindicate his belief, and he built an engine to demonstrate his belief. The machine was not larger than the hand-cars used by workmen to transfer themselves from place to place; and, as the speaker now recalls its appearance, the only wonder is, that so apparently insignificant a contrivance could ever have been regarded as competent to the smallest results. But Mr. Cooper was wiser than many of the wisest around him. His engine could not have weighed a ton, but he saw in it a principle which the forty-ton engines of to-day have but served to develop and demonstrate.

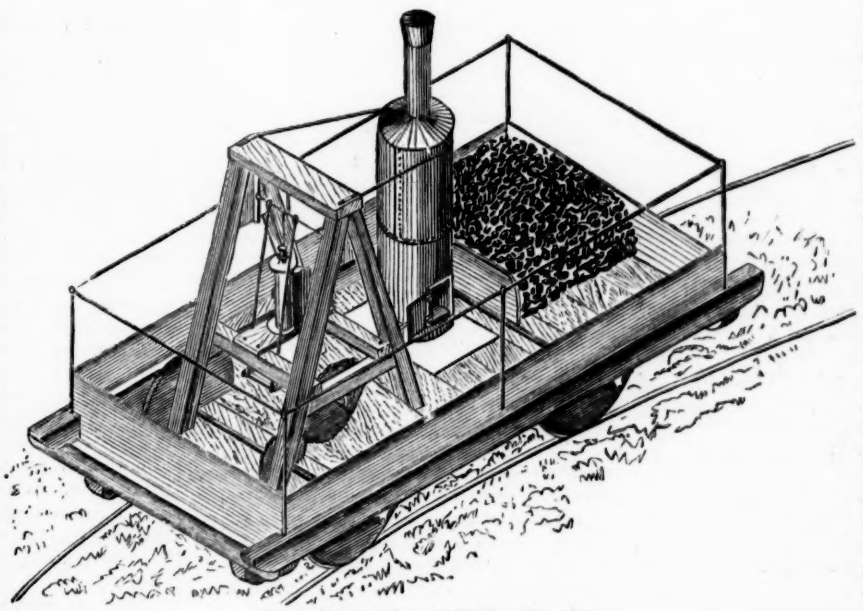
"The boiler of Mr. Cooper's engine was not as large as the kitchen boiler attached to many a range in modern mansions; it was of about the same diameter, but not more than half as high. It stood upright in the car, and was filled above the furnace, which occupied the lower section, with vertical tubes. The cylinder was but three and a half inches in diameter, and speed was gotten up by gearing. No natural draught could have been sufficient to keep up steam in so small a boiler; and Mr. Cooper used, therefore, a blowing-apparatus, driven by a drum attached to one of the car-wheels, over which passed a cord that in its turn worked a pulley on the shaft of the blower. Among the first buildings erected at Mount Clare was a large car-house, in which railroad-tracks were laid at right angles with the road-track, communicating with the latter by a turn-table, a liliputian affair indeed compared with the revolving platforms, its successors, now in use.

"In this car-shop Mr. Cooper had his engine, and here steam was first raised; and it seems as though it were within the last week that the speaker saw Mr. George Brown, the Treasurer of the company, one of our most estimable citizens, his father, Mr. Alexander Brown, Mr. Philip E. Thomas and one or two more, watch Mr. Cooper as with his own hands he opened the throttle, admitted the steam into the cylinder, and saw the crank-substitute operate successfully with a clacking noise, while the machine moved slowly forward with some of the bystanders, who had stepped upon it. And this was the first locomotive for railroad purposes, ever built in America; and this was the first transportation of persons by steam that had ever taken place on this side of the Atlantic on an American-built locomotive.

"Mr. Cooper's success was such as to induce him to try a trip to Ellicott's Mills, on which occasion an open car, the first used upon the road already mentioned, having been attached to the engine and filled with the directors and some friends, the speaker among the rest, the first journey by steam in America on an American locomotive was commenced. The trip was most interesting. The curves were passed without difficulty, at a speed of fifteen miles an hour, and the grades were ascended with comparative ease. The day was fine, the company in the highest spirits, and some excited gentlemen of the party pulled out memorandum books, and, when at the highest speed, which was eighteen miles an hour, wrote their names and some connected sentences, to prove that even at that great velocity it was possible to do so. The return trip from the Mills, a distance of 13 miles, was made in 57 minutes. This was in the summer of 1830, but the triumph of this Tom Thumb engine was not altogether without a drawback. The great stage proprietors of the day were Stockton and Stokes; and on that occasion a gallant gray, of great beauty and power, was driven by them from town, attached to another car on the second track—for the company had begun by making two tracks to the Mills—and met the engine at the Relay House on its way back. From this point it was determined to have a race home; and, the start being even, away went horse and engine, the snort of the one and the puff of the other keeping time and time.

"At first the gray had the best of it, for his steam would be applied to the greatest advantage on the instant, while the engine had to wait until the rotation of the wheels set the blower to work. The horse was perhaps a quarter of a mile ahead, when the safety-valve of the engine lifted, and the thin blue vapor issuing from it showed an excess of steam. The blower whistled, the steam blew off in vapory clouds, the pace increased, the passengers shouted, the engine gained on the horse, soon it lapped—the silk was applied—the race was neck and neck, nose and nose—then the engine passed the horse, and a great hurrah hailed the victory. But it was not repeated, for just at this time, when the gray master was about giving up, the band which drove the pulley, which moved the blower, slipped from the drum, the safety-valve ceased to scream, and the engine, for want of breath, began to wheeze and pant. In vain Mr. Cooper, who was his own engineer and fireman, lacerated his hands in attempting to replace the band upon the wheel; in vain he tried to urge the fire with light-wood: the horse gained on the machine and passed it, and although the band was presently replaced, and steam again did its best, the horse was too far ahead to be overtaken, and came in the winner of the race. But the real victory was with Mr. Cooper, notwithstanding. He had held fast to the faith that was in him, and had demonstrated its truth beyond peradventure. All honor to his name! In a patent-case, tried many years afterward, the boiler of Mr. Cooper's engine became, in some connection which has been forgotten, important as a piece of evidence. It was hunted for and found among some old rubbish at Mount Clare. It was difficult to imagine that it had ever generated steam enough to drive a coffee-mill, much less that it had performed the feats here narrated."





*First Locomotive built in America.*

A comparison of the engravings of Mr. Cooper's engine and those we published last week of the Baldwin locomotive will be sure to excite a smile. The first, with fuel and water, Mr. Latrobe informs us, *could not have weighed a ton*, while the last, with its tender, weighs more than *fifty tons*.

Those acquainted with the character and reputation of Mr. Cooper will be interested in the following letter written by him to Mr. Brown, the author of "The History of the First Locomotives in America," and to whom we are indebted for the engravings and from whose book we have made the quotations herewith. The letter was written to explain the cause which led the writer to deviate from the path of his legitimate business to become a builder of locomotives:

"NEW YORK, May 18, 1869.

"MY DEAR SIR: In reply to your kind favor of the 10th inst., I write to say that I am not sure that I have a drawing or sketch of the little locomotive placed by me on the Baltimore & Ohio Railroad, in the summer of 1829, to the best of my recollection.

"The engine was a very small and insignificant affair. It was made at a time when I had become the owner of all the land now belonging to the Canton Company, the value of which, I believe, depended almost entirely upon the success of the Baltimore & Ohio Railroad.

"At that time an opinion had become prevalent that the road was ruined for steam locomotives, by reason of the short curves found necessary to get around the various points of rocks found in their course. Under these discouraging circumstances many of the principal stockholders were about abandoning the work, and were only prevented from forfeiting their stock by my persuading them that a locomotive could be so made as to pass successfully around the short curves then found in the road, which only extended thirteen miles, to Ellicott's Mills.

"When I had completed the engine, I invited the directors to witness an experiment. Some thirty-six persons entered one of the passenger cars, and four rode on the locomotive, which carried its own fuel and water; and made the first passage, of thirteen miles, over an average ascending grade of eighteen feet to the mile, in one hour and twelve minutes. We made the return-trip in fifty-seven minutes.

"I regret my inability to make such a sketch of the engine as I would be willing to send you at this moment, without further time to do so.

"Yours, with great respect,
"PETER COOPER."

Of the trial of this engine Mr. Ross Winans made a report to the President of the Baltimore & Ohio Railroad, from which we make the following extracts:

"Mr. Cooper's engine has but one working cylinder of three and one-fourth inches diameter, and fourteen and a half inches stroke of piston, with a boiler proportionably small, or nearly so. The wheels of the engine to which the motion is communicated are two and a half feet in diameter, making it necessary to gear with a wheel and pinion to get speed, by which means a considerable consumption of power is experienced.

"Mr. Cooper's engine has to-day moved a gross weight of four and a half tons from the depot to Elliott's Mills and back in the space of two hours and ten minutes, which, as you are aware, the distance being twenty-six miles, gives an average speed of twelve miles to the hour. As the engine returned with its load to the same point whence it started, the acclivities and declivities of the road were, of course, balanced; and at least as much time and power (if not more) were required to traverse the whole distance as would have been on a level road; therefore Mr. Cooper's engine exhibited an average force during the time it was running of 1.43 horse power, or nearly one and a half, which is more than three times as much power as the Rocket exhibited during the experiment above described, in proportion to the cylindrical capacity of the respective engines. This, no doubt, originated in a considerable degree from the steam being used in Mr. Cooper's engine at a higher pressure than in the Rocket. We are, however, not able to come to any very correct conclusion as to what extent this cause prevailed (Mr. Cooper's steam-gauge not being accurately weighed) which prevents a more minute comparison being made. It may be said that subsequent practice and experience with the Rocket have enabled her constructor to produce more favorable results, which is no doubt the case; but we have every reason to expect a similar effect with regard to Mr. Cooper's engine, judging from what we have witnessed, each exhibition of its power being as yet an improvement upon the one that preceded it. It is, however, too small and too temporary in its construction to expect a great deal, from the friction of the parts; the heat lost in a small engine being much greater in proportion to the power than in a larger one. But to-day's experiments must, I think, establish beyond a doubt the practicability of using locomotive steam power on the Baltimore & Ohio Railroad for the conveyance of passengers and goods at such speed and with such safety (when compared with other modes) as will be perfectly satisfactory to all parties concerned, and with such economy as must be highly flattering to the interests of the company. It has been doubted by many whether the unavoidable numerous short curves on the line of your road and inclined planes would not render the use of locomotive power impracticable; but the velocity with which we have been propelled to-day by steam power round some of the shortest curves (to wit, from 15 to 18 miles per hour) without the slightest appearance

of danger, and with very little, if any, increased resistance, as there was no appreciable falling off in the rate of speed, and the slight diminution in speed in passing up the inclined planes, some of which were nearly 20 feet to the mile, must, I think, put an end to such doubts, and at once show the capability of the Baltimore & Ohio Railroad to do much more than was at first anticipated or promised by its projectors and supporters.

"Very respectfully, ROSS WINANS."

## Contributions.

### THE REFINED TORTURE OF GRAND CENTRAL DEPOTS.

TO THE EDITOR OF THE RAILROAD GAZETTE:

There are great follies in the world as well as small ones, and I think there is a growing danger of our immense railroad corporations committing some stupendous blunders in endeavoring to erect magnificent monuments for some ambitious individual or individuals in the shape of grand union depots.

Now, there is no question whatever that it is of the very greatest importance that every city should, as nearly as possible, have all its railroads from all directions concentrated at one point. That is one of the greatest improvements of this rapidly improving age.

But what I fear is, that in attempting to inclose all out of doors, comparatively speaking, they come in competition with two of Nature's greatest attributes, sunshine and the free circulation of fresh air.

Many persons seem to be unaware of the vital importance of the free admission of the direct rays of the sun into all occupied places.

The great failure of the skating rinks, so fashionable but a few years since, was no doubt owing to the confined air and the want of sun-light, which gave them that damp, chilly and unwholesome feeling so characteristic of these places.

We must remember that the direct rays of the sun are very powerful. Even in winter, a thermometer placed in the sun, and protected from the air, will soon rise to 150 degrees or 200 degrees. Now, add to this damp, chilly, unsunned air the smoke and gas from numerous engines, which are often met with in very large depots, and we have a very uncomfortable atmosphere accumulated there.

And, again, if there is a large amount of sunlight admitted through glass roofs, it is liable to be uncomfortable in summer, from the accumulated heat from direct radiation and the confined air. This again is generally remedied by painting the glass over a dark green, which obstructs so much light that it is quite impossible to read in the cars on a cloudy day.

It seems to me that a much simpler plan is really a great deal better, all things considered—a plan similar to that adopted by the Pennsylvania Railroad at Pittsburgh—of having a simple shed roof to cover two tracks and a sidewalk sufficient for passengers to get from one train to the other partially sheltered.

This leaves the sides all open for a free circulation of air and sunlight, and, I think, gives a much greater amount of satisfaction to the travelers.

But oh, then there comes in the great drawback of its simplicity. How can the president, the directors and engineers miss so grand a chance of immortalizing their names by building so magnificent a structure in the great cities.

I think the man ought to be crowned with immortal fame who would invent some equally efficient system of glorifying these important officials without torturing the many millions of poor travelers who are obliged to use these extravagant structures.

So much for the general structures. Now, how much attention is paid to the comfort of the travelers who are obliged to wait for a few moments or a few hours in the waiting-rooms of these palatial establishments?

I had occasion to stop over a train in Cleveland the other day, and, feeling quite unwell, stopped for a considerable time at the great Union Depot on the lake, and, oh, what a time I had of it!

The gentlemen's sitting-room opened, of course, directly into the great space roofed over and called the Grand Depot—an immense space, just sufficiently inclosed to keep out the warm, genial sun, and yet open enough to allow of the full sweep and force of the cold northwest wind blowing directly from the lake.

In the center of the sitting-rooms was a stack of steam radiators, and around against the cold outside walls were permanently arranged rows of substantial, heavy, upholstered seats, of the most uncomfortable pattern ever invented, in which it was quite impossible to rest your aching head, either upon the back of the seat or upon your hand, as the arms, I should think, were not over six or eight inches high. The cold, damp air, saturated with the gas and smoke from the stoves and engines, came sweeping in at each end, as the doors were constantly opening and shutting; and the floor was as cold as a barn, and the only possible way to get your feet warm was to go and stand on one foot while you held the other one up about as high as your knee against the steam heater to get warm.

I walked up and down, hoping to discover some stove or boiler or cooking-range, with an old-fashioned splint-bottom chair, or something made for comfort instead of show, in which I might sit down and warm my feet; but all in vain. At last I found open a door of a car standing on the track, and found it quite warm and comfortable, and was just luxuriating in a good seat by a stove still gently warmed by the dying embers of the remains of a noble fire, when two women approached me with their brooms and requested me to leave, as they were going to clean the car, as it had just come in with a train that stopped there. As I wandered from room to room, each one seeming a little more uncomfortable than the other, if possible, I kept repeating to myself, "What refined torture! Could the inventions of the old Inquisition much excel this?" Will our railroad managers ever discover that, if there is one thing more desirable than another in a railroad sitting-room, it is an opportunity to thaw your frozen feet, comparatively speaking, which freezing seems inevitable with the methods of heating in vogue on so many of the roads. If no better arrangement can be found, adopt the plan of running the smoke-pipe from the stove around near the floor in front of the seats and cover it with coarse wire; or, where steam pipes are used, they might be run around the room, so that they could be used for the comfort of the passengers stopping.

In striking contrast with this was the impression made upon stopping at a station for breakfast in Indiana, the building being an ordinary old-fashioned, long, wooden building, with clean, bright windows on both sides, and with an immense cast-iron stove, long enough to take in a whole cordwood-stick without cutting. There had been a large fire and the room had been well heated, and then the draught closed perfectly tight, so that the coals were just smouldering in this great oven, which gave very much the effect of the celebrated Russian oven. The effect of such a bright, cheerful room, thus genially warmed, was perfectly magical. The bright smiles of gladness and joy were visible on every countenance.

A careful observer will soon notice that it is not in these grand and costly piles that the most comfort is to be found, but it is in much simpler and unpretending arrangements generally. In the new and really magnificent Grand Central Depot of New York, I noticed in all the sitting-rooms I examined that there was not one single thought of ventilation, not a square foot, not an inch provided for the escape of the foul air from any of the rooms. I should say, however, that this examination was before they were entirely completed, and they may have discovered this omission in time to have remedied the defect before it was fairly open to the public. If not, would it be uncharitable to hope (it would be hoping in vain, I know,) that some accident might happen that would cause the great railroad king who projected this depot to be confined in some of those rooms for a few hours?

L. W. LEEDS,
Engineer of Ventilation and Heating.

### APPLICATION OF TILE DRAINS TO RAILWAY WORKS.

[Paper read before the Civil Engineers' Club of the Northwest, December 11, 1871, by Charles Paine, Chief Engineer of the Michigan Southern Division, Lake Shore & Michigan Southern Railway.]

I submit to the Club a memorandum of some experiences in the application of tile drains to railway works.

There is no doctrine which has been more emphatically taught by the fathers of engineering, nor more dwelt upon in text-books, than the necessity for the thorough drainage of earth works, in order to secure their stability; yet there is in this country, among railway engineers particularly, a practical ignoring of its value only to be accounted for by that indifference which long neglect usually produces.

Some effort is commonly made, on well-conducted railroads, to get rid of the surface water in cuttings by ditches at the side of the ballast; which serve a useful purpose during summer showers, but are completely obstructed by the wash and falling in of the slopes during the heavy fall rains, when the ballast becomes saturated with water just as winter comes on to freeze it solid and throw the track about in every direction. In spring, matters are worse; nothing can be done but to hoe out small trenches in the soft mud, to let off the flood and await its subsiding; then the ditches are opened again, to remain so only while there is no water running in them. Of course there are many exceptions to this condition of things, and, on many gravelly soils, engineers do not dream of the sufferings of their brethren in charge of the maintenance of way where the cuttings are through clay; but these will admit that I have only feebly described the course of events upon such railways.

It was my misfortune to inherit some very aggravated cases of sloughing slopes, in long, deep cuttings. Upon looking around to learn how such difficulties as I have described had been met, I found that heavy stone walls, or rows of piling, or docking, at the feet of the slopes, had been frequently resorted to, but without much success. A farmer, who had been very successful in draining land, told me that he knew he could drain these cuts in the same way, with tiles; and, having observed for myself the complete removal of the water from wet lands by their use, I resolved to try them in one cutting, selecting the worse case for the experiment.

In the summer, the ditches were cleaned out to an even grade, two feet below the rails; then the narrow trench for the tiles was excavated, and the tiles laid at a depth of three and a half feet below the bottom of the ditch. Wherever any spring or considerable ooze from the side of the slope was discovered, a small drain was led down from it into the main drain, keeping always at least three and a half feet below the surface, so as to be beyond the reach of frost. Although the cutting seemed at this time very dry, a discharge from the tiles commenced at once and has continued without intermission until now, a period of three years, increased in volume by any rains, but never ceasing. The effect upon the slopes during next spring was awaited with some anxiety, as the job had been a long and rather expensive one; but the farmer's judgment was vindicated—there was no slipping along the whole cutting; the feet of the slopes, having been kept dry, offered a firm abutment to maintain the upper strata in their position. The track had also shown the benefit of this deep drainage, the foreman declaring that it "had not hove more than if it was on a bank." As the spring advanced it was found that the seeds sown by the winds of the preceding autumn, not having been sloughed off and carried away, were covering the naked slopes with a verdure both protecting and beautifying. There has been no occasion for the mud train to carry a load out of this cutting since the tiles were laid, where previously the utmost exertions of a large gang of men could only maintain a precarious passage for the traffic during several weeks of each spring. Upon the railway where I am employed we have now laid down about forty-five miles of these tile drains in cuttings, not having been disappointed in our expectations in any case. The desirableness of having five feet of drained material under the sleepers during our severe winters has rendered all our track force advocates of and ardent assistants of tiling.

We use tiles of good brick clay, well buried, each one foot long, of two, three, four, five and six inches diameter (the smallest size only for branches from the main drains), proportioning the length of each size in a cutting according to the volume of water to be discharged. At a short distance from the end of each drain we lay a trap, made from the same clay as the tiles, to prevent the intrusion of moles, snakes, frogs, etc., which seem to select the tiles as a cool summer retreat during the dryer months, when many of the drains do not discharge. We generally use a layer of straw or moss over the tiles to exclude the finer materials of the filling; we have used tarred paper, also, as a covering for the joints, all with equal success. I believe good firm clay is the best, because the most imperishable. Late in autumn, when it seemed that clay might not consolidate quickly enough to make a firm filling between the sides of the trenches before winter, we have used sand and gravel for filling the trenches. In some cases of bad quicksands, which filled the tiles rapidly with solid material, the sand was excluded by stamping sods into the concave bottom of the trench, laying the tiles, and covering the joints with other sods.

Two facts seem established: that the water enters the joints of the tiles chiefly from the underside; and that, if the tiles are once laid, the water will find its way into them through any covering.

Among incidental advantages derived from these drains, it may be mentioned that the workmen esteem them for furnishing an abundance of cold water convenient to the road; and in two cases where the quantity of water at a neighboring station was insufficient, the drains were turned into the wells, affording enough for the supply of the locomotives.

For the effectual drainage of large areas of ground, such as terminal stations covered with tracks, where surface ditches are out of the question, the tiles, sunk below frost and provided with proper outlets, are the simplest and, indeed, the only perfect means. Their employment for the removal of water from behind masonry suggests itself.

The cost of laying the tiles in cuttings, where we have paid for the labor by the day, has been about seventy-five cents per rod; and we now contract for the labor at this price.

The work requires a few special tools, but not a high degree of skill, only faithfulness. Engineers will see that only round pipes should be used, as all other forms

move out of line, if moved at all, while round ones will only revolve in their beds.

The prices paid for tiles this year are as follows:

| | | | | |
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| For 2 inches | diameter | of | hole | $10 per M. |
| For 3 | " | " | " | 15 " |
| For 4 | " | " | " | 22 " |
| For 5 | " | " | " | 40 " |
| For 6 | " | " | " | 60 " |

## Heavy Locomotives and Light Rails—Dead Weight—Preaching and Practice.

Among other important discoveries in this age of progress is this, that we have been for nearly forty years doing a ruinous business by running about the country thousands of tons of useless and costly material, for the purpose of securing the privilege of carrying a few tons of paying freight. At least we are led to these conclusions by recent discussions on the question of dead weight, which, although they have not as yet resulted in any movement toward reducing the weight of rolling stock, will, doubtless, result beneficially in that direction so soon as some of our leading engineers recover from the temporary excitement into which they seem to have been thrown by the advocates of the "narrow-gauge system."

It is highly probable that the weight of cars will soon be greatly reduced without injury to their carrying capacity; but the most important object to be secured in this matter of dead weight is to bring the weight of locomotives down as nearly as possible to that of loaded cars. The tremendous weight carried on locomotive driving wheels, although in the highest degree destructive to permanent way, is a necessary evil and, for obvious reasons, will be difficult if not impossible to dispense with. The great and seemingly extravagant weight of our locomotives has long been a cause of complaint; yet those who preach against the practice of using heavy locomotives are continually ordering heavier ones. It is an every-day complaint of some of our prominent railroad men, that the expense of maintenance of permanent way is ruinous beyond anything else in railway practice; yet these men are loud in their demands for heavier locomotives. This demand is the offspring of false reasoning, or rather the want of any reasoning. Years ago, when railroads were not handling a tithe of the freight they do now, a light locomotive was sufficient; but, as traffic increased and a higher rate of speed for passenger trains was necessary to satisfy the demands of the public, the locomotive began to increase fearfully in all its proportions. What else could be done? It required cylinders of a certain size to perform a given amount of labor, and the boiler must be of the proper dimensions to supply these cylinders; therefore, when the boilers and cylinders were not equal to the power required, they must be enlarged, which involved a proportionate enlargement of all other parts to preserve their relative strength. The weight of cars has been gradually on the increase from a similar cause, and for this growing evil there seemed to be no remedy. But, great as the necessity for heavier rolling stock may have appeared to be, the weight has been unnecessarily increased by the use of inferior quality in its construction. By using none but first-class material and making all the parts of the proper form to secure the greatest strength, a great deal of useless weight may be got rid of; but it is impracticable to reduce the weight of locomotives to such an extent that they will not be far more destructive to permanent way than any other rolling stock.

When a mechanic designs a heavy locomotive for freight service, he maintains all its relative proportions, in order that no weaker part shall be sacrificed to the stronger, or, as Holmes has it in his "One-hoss Shay," "the weakes' place must stan' the strain." Not so, however, with those who order those monsters and put them to use. They set them at work on thin ribbons of rails which bend like hoop-poles under the tremendous weight, while the heaviest laden car deflects the rail but slightly, if at all. This is why we see those large figures at the left of the repair accounts of road and machinery; for the overgrown "ten-wheeler" not only destroys the way for lighter rolling stock, but tears himself in pieces on the rough way he has prepared for himself, assisted by others of his class.

There is much truth in the homely old saying that "Where there's a will there's a way;" but it is not easy to see a way of building a locomotive capable of doing a lively business without its disturbing permanent way greatly in excess of heavily freighted cars, without a change in the entire system.

And perhaps the present system may be changed to advantage; at all events the present system is far from being satisfactory, and the ever-restless American brain is on the alert for something new—for another great step *forward*. Indeed, the demand for a change of system is so urgent that not a few advocate taking a step *backward*—a move not suited to the tastes or habits of the American people.

If the weight of locomotives could be reduced to that of a freight car with its maximum load, one important step will have been gained; but as this is conceded to be impracticable, something may be accomplished by commencing at the bottom of the difficulty. Suppose a weight of 20 pounds per yard be added to rails, or suppose we make rails to weigh 90 pounds per yard (or 100 pounds, if necessary), and lay them on 3,500 good ties to the mile, which, together with plenty of good ballast, will *make a track capable of supporting a freight traffic of* 20 *tons to the car!* With such a track as can be built with something like the above-mentioned material, it would not be a difficult matter to build cars that could be run with safety with a load of 20 tons, which, together with the weight of the car, would bring a weight on the wheels approximating that on the locomotive driving wheels. Of course the weight of the cars must be considerably increased to make them safe under a load of 20 tons, but this increase would not necessarily be so great as to render the change unprofitable. In this manner the proportion of dead weight to paying load would be much less than at present. A train of 10 cars would contain as much freight as one of 20 does under the present system. The cost of building a car capable of carrying 20 tons should not exceed, if it equaled, the expense of two of a capacity of 10 tons each, so that this change would not involve any extra expense. Locomotives could be so reduced in weight as to be furnished for perhaps $3,000 less than at present. If the extra cost of the heavy iron should reach $1,000 per mile, a road employing 20 of the present heavy type of locomotives would save enough in the cost of motive-power to build 60 miles of the heavy track. To this may be added the saving of much power that is now absorbed in friction, which implies a saving in fuel, an immense saving in the expense of track and rolling-stock repairs, a saving in oil, and more paying and less dead weight. In England the weight of locomotives has been rapidly on the increase, and the weight of rail has been correspondingly increased, so that English roads have not suffered from the destructive effect of heavy rolling stock as have American roads. English rails have risen from 28 pounds per yard to 90 pounds. Locomotives have risen from 10 tons to 40 tons, with a speed of 60 miles an hour, at which they run with safety. With a heavy rail, well supported, they run passenger engines with a weight of 15 tons on a single pair of drivers, and no serious complaint is made of excessive injury to permanent way. One can readily imagine what the condition of American roads would be after a few months' trial of the English locomotives. But if they can keep their roads in first-class condition under a speed of 60 miles per hour, with 15 tons to a pair of drivers, there should be no difficulty in keeping up American roads under a load of 20 tons per car of eight wheels, and with the most approved type of American locomotive, with four coupled drivers. The narrow-gauge men profess to be able to carry 10 tons per car on their toy roads at 30 miles an hour, on rails of 20 pounds per yard. If this be true, the proper way to reduce the ratio of dead weight to paying load to a satisfactory degree would seem to be an increase in the weight of rail, and making the weight of loaded cars as nearly as possible that of the locomotive. The saving that could be made in various ways (repairs to track, machinery, etc., and gain in paying load) would more than cover the expense of the change. The light rails now in use could, perhaps, be disposed of to good advantage to the narrow-gauge men.

WM. S. HUNTINGTON.

## Concerning Grades.

NEW YORK, December 19, 1871.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your issue of the 16th, T. J. Nicholl says: "In places where a certain elevation has to be made, it is better to have short, heavy grades, interspersed with levels, than one continuous, moderate grade;" or, in other words, if in 10 miles you must rise 1,000 feet, you should have one mile of 200 feet grade, one mile level, etc., instead of a uniform grade of 100 feet to the mile. Is the above opinion sustained by any experiments to which you can refer me, or is it simply a case of "practical man?"

I would like, also, to ask why the wear on the outside rails of 10-minute curves "is greater in proportion" than on 30 or 60 minute curves, subtended by equal central angles. Yours truly, N.

[Our correspondent seems to have the idea that we indorse all the opinions expressed by our contributors. If we published only such contributions as we can entirely agree with, we fear we should be obliged to exclude the majority of those which have appeared in our columns. An editor of a paper is, to some extent, like the chairman of a public meeting, he should tolerate the freest expression of opinion so long as it is addressed to the subject under discussion, and if he does not agree with what is said, he often has no right either to silence the speaker or to injure the effect of what has been said, by expressing an opinion adverse to it. An editor is, however, often called upon to exercise a judicial function, after both sides in a discussion have been heard, and by summing up present the case in a clearer light than is possible for them to see it, who look at it only from one side.

Mr. Nicholl will, doubtless, be glad to answer the questions asked by "N."—EDITOR RAILROAD GAZETTE.]

## ILLINOIS & ST. LOUIS BRIDGE.

### *Report of the Chief Engineer, October, 1871.*

*To the President and Directors of the Illinois & St. Louis Bridge Company:*

GENTLEMEN: I have the honor to make the following report:

MASONRY.

The total amount of masonry of every kind, including brickwork, laid up to this date is 68,713 cubic yards. There remains yet to be laid 33,902 cubic yards.

EAST APPROACH.

The foundations of the five piers and towers of this approach have all been built, and are now completed ready to receive the sandstone, excepting pier No. 2, the red granite being laid up, including the wash-course, on all of them with this exception.

These approach piers (excepting No. 5, to which the towers are attached) were all sunk by the same process used in sinking the large ones. This was believed to be more certain and economical than by coffer-dams, the method used on the west approach. The result has fully confirmed this opinion. With pier No. 2 the coffer-dam would have proved very expensive, as this pier encountered in its descent the hulk of an old and strongly-built ferryboat. Its planks were three inches thick, and floor-timbers four by eight inches square. This hulk had to be cut away to permit the descent of the pier, which has gone directly through it, the kelson of the wreck having been intersected by the caisson. This altogether unexpected difficulty has delayed the completion of this pier about three weeks. It has now passed this obstruction, and needs to be sunk only one foot more to reach its final destination.

It has not been deemed necessary to sink the foundations of the first four piers of this approach deeper than 12 feet below extreme low-water mark. The caissons used are made wholly of oak timber, excepting only the air-locks and the spikes and bolts used in fastening the timbers together. They are ten feet high, consequently they are entirely below low-water line, while the masonry extends only down to that line. The surface of the wharf will be about nineteen feet above the bottom of the foundation of No. 1, and about thirty-two feet above that of No. 4.

The towers and pier No. 5 are laid on a foundation of concrete six feet deep, under which a system of piles was first driven to an average depth of twenty-five feet. The concrete is based fifteen feet above low-water line.

The east abutment pier, resting on the rock at the depth of 136 feet below high-water mark, and standing between these approach piers and the river; and the wharf pavement covering the river shore will, I think, be amply sufficient to prevent the current of the stream from ever affecting the foundations of these small piers.

From the towers eastward the upper roadway of the bridge will be carried by trestling to Fourth street, in East St. Louis, with a grade of four feet to the 100 feet. The railways will curve out to the north from under the upper roadway, immediately east of the towers, and will be of such grade and construction as shall be determined upon by the railroad companies who have contracted to use the bridge and who will pay for these railways. A sixty-eight foot grade will bring the railways down to the level of the present tracks in East St. Louis within a distance of about 3,000 feet.

EAST ABUTMENT.

This pier has had no work done upon it during the last four months. It is completed on the river front to within two courses of the wash-course. The wash-course is the one immediately below the lower tier of skewbacks.

On the *T* wall the red granite is now being laid, four courses being required to finish it ready for the sandstone. The sandstone commences upon the wash-course, which course in the *T* wall is of red granite, and corresponds in height with the wash-courses of the approach piers on each shore.

EAST PIER.

The masonry of this pier lacks two courses of being high enough to set the lower tier of skewback plates. These will be laid while the contractors are setting the plates on the west pier. There being but one outfit of hoisting apparatus for carrying up the masonry of these two piers, it is alternately used at each. At present no work is being done on this pier. It will, however, be finished considerably in advance of the wants of the contractors for superstructure.

WEST PIER.

The masonry of this pier has been carried up high enough to receive the lower tiers of skewback-plates, where it must rest until these are fixed against it. The stone-cutters are now engaged in making the necessary recesses in the granite to receive the plates, and so soon as this shall have been completed, these plates will be set. This pier will be completed about the 1st of February next. The necessary steel and iron work for it are in such a state of forwardness that no further delay need be feared in its completion.

WEST ABUTMENT.

The masonry has been carried upon the *T* wall or western face of this abutment to a level, four courses below the springing of the first stone arch over the St. Louis wharf. This portion of the masonry (the *T* wall) is of sandstone. On the river front of the pier masonry is finished to a level five courses lower than the *T* wall, and is now ready to receive the lower tier of the skewback-plates. These four plates are now ready, and will immediately be set by the contractors for the superstructure. So soon as this shall have been done the masonry of this side of the pier will be carried up to receive the second tier of skewback-plates.

These skewback-plates are seven feet by three and two-thirds feet, six inches in thickness; and to insure an equal bearing against the granite throughout their entire area, iron cement will be driven in between them and the stone after they are in proper position. This work must be done before the next courses of granite are laid above the plates. These plates will sustain the entire thrust of the arches. It is against them that the skewbacks of the arches will rest. The skewbacks are of wrought-iron, and will be firmly secured to the masonry by large anchor-bolts passing through them and the skewback-plates into the abutments, where the bolts will be fastened to cast-iron anchor-plates built in with the masonry. Into the upper and lower tiers of skewbacks the cast-steel tubes which form the upper and lower members of the arches will be inserted. The anchor-bolts are five and three-fourths inches in

diameter. Some are made of steel and others of iron, according to the different degrees of strain to which they will be subjected. The lower skewbacks will each have four bolts and the upper ones three. These bolts will sustain no portion of the weight of the arches. Their object is simply to prevent any movement at the ends of the arches which would otherwise occur from extremes of temperature and excessive inequality in the distribution of load upon the arches.

When the second tier of skewback-plates are fixed upon this abutment, the remainder of the masonry of it will be rapidly completed. I see no reason now to fear any further delay in this part of the work, and think the masonry of this pier will certainly be completed by next February.

WEST APPROACH.

The piers of this approach over the St. Louis wharf are all up to the springing of the arches which they are intended to carry, except pier No. 5.

One complete sandstone arch is turned upon piers Nos. 2 and 3, and about one-fourth of an arch is turned upon the centering on each side of this completed arch. The other two arches of this approach cannot be started until the T wall of the west abutment is four courses higher and pier No. 5 is completed. This pier stands in the house-line of the wharf, and is completed from the rock to the wash-course inclusive, and is, therefore, ready to receive the sandstone on the red granite base-course.

The foundation of the south tower is also completed to the same extent, and sandstone is being laid now on this pier and tower. The foundation of the north tower has just been commenced.

Between the wharf and Commercial street the masonry is well advanced, piers No. 6, 7 and 8 being completed. On these piers is now being placed the centering for the brick arches which will surmount them, each arch having twenty-seven feet span.

Piers Nos. 8 and 9 stand on opposite sides of Commercial street, twenty-seven feet apart. Each is completed ready for the centering of the arch, which will soon be placed in position on them.

Piers Nos. 9, 10, 11 and 12, standing on the block between Commercial and Main streets, are all completed, and the three brick arches (twenty-six and a half feet in diameter) upon them are likewise completed. The spandril spaces between these arches are being filled with ballast to level up for the railway sleepers. The vaults under the arches between the wharf and Main street are inclosed by substantial masonry, and the rooms thus formed are connected by arched doorways through the piers. A large warehouse is thus created on each of these blocks, which will be available for revenue. Arched entrances are provided to these apartments through the piers on Main and Commercial streets.

The land over which the approach is carried further west is similarly utilized for warehousing purposes as far as to the middle of the block between Second and Third streets.

Pier No. 12, now finished, forms the eastern abutment on Main street for the support of the truss which carries the roadways over that street.

Pier No. 13, on the west side of Main, is built up from the rock to the street level, and the sandstone work on it is progressing. From this point west no large piers occur, except on each side of the alley between Main and Second and on each side of Second street, at which point abutment piers are being placed to sustain the iron trusses for carrying the roadways over these thoroughfares. The foundations for all of these abutments are built up to within one or two feet of the street levels, and sandstone work is progressing on one of them on Second street. The others are covered at present with hoisting machinery and wagon-ways for transporting materials. From Main street to the middle of the block between Second and Third streets, the railways and roadways will be supported on strong side-walls of masonry, and two rows of brick pillars placed equi-distant between these walls. These side-walls are almost entirely completed, ready for receiving the railway timbers, from Main street to the end of the approach at Third street. Between Second and Third streets they are still more advanced, being nearly completed for the upper roadway.

The brick pillars between these side-walls are well advanced, east of Second street to the alley, one tier being nearly completed to the level of the railway beams.

The entire masonry for the west approach, from the levee to Third street, will be completed ready for the superstructure, I think, by the middle of January next.

## SUPERSTRUCTURE.

CAST STEEL.

The Keystone Bridge Company, contractors for superstructure, have made but little progress in their contract, owing chiefly to delays in obtaining the proper quality of steel and iron for the work. The contract for steel was let by them to the William Butcher Steel Works, near Philadelphia. Extensive additions, consisting of buildings, furnaces, rolling-mill, straightening machines, etc., were made in the works, and every indication seemed to encourage the belief that the steel would be promptly supplied. Unforeseen delays, however, occurred in getting the necessary machinery into proper working order.

The first large forgings required by the bridge were steel anchor-bolts, five and three-quarter inches in diameter, and from twenty-two to thirty-six feet long. The first bolts, when tested, were found to be of inferior quality. Having been injured in forging, they were broken by testing. Each bolt is required to sustain, when tested, a tensile strain of 519 tons, without being permanently elongated, being twice as much as the maximum strain to which it can be subjected in the bridge. Before this test could be applied to the defective ones sufficiently to prove their weakness, the testing machine itself was broken twice. This involved several weeks' delay. When the defects of the machine were remedied, the inferiority in the bolts was fully discovered. New mixtures of steel had then to be tried, and greater care was used in its manipulation. Many bolts were made before the testing machine was repaired and could reveal these defects. These were, of course, rejected when tested, and others had to be made in their stead.

In the novel operation of testing such large forgings, and in the management of the machine itself, when exerting such great strains upon them, many unexpected accidents occurred, both to the machine and to the instruments required for measuring the extensions of the bolts and the amounts of strain imposed upon them. For instance, a piece of one of the bolts, which weighed over 1,000 pounds and twenty feet in length, was shot out of the machine like an arrow, when the bolt broke, and fell fifty or sixty feet distant; while the other end of the bolt reacted with such force upon the machine as to break the piston-rod or pulling-bolt by reversing the tensile strain upon it, thus driving it out of the ram at the other end of the hydrostatic cylinder, and breaking by its reactive force the fastenings by which it was secured.

The expense of testing was assumed by the Keystone Bridge Company in its contract, and it in return sub-let this part of the work, so far as it relates to the steel, to the Wm. Butcher Company. The design, construction and repairs of the necessary testing machines and appliances are, therefore, a part of the province of the contractors, they simply agreeing to subject the various materials to the requisite strains under the supervision of the chief engineer of the bridge, or of his assistants, the instruments by which the strains are measured being all that is supplied by the Bridge Company.

By these various delays several months were lost before any bolts were supplied capable of sustaining the strain above named. These difficulties were, however, fully overcome, and twenty-four bolts have been thus tested and received. Eighteen of these were sent more than three weeks ago to the Keystone Bridge Works at Pittsburgh to have screws cut upon them. Others are being made from day to day at the steel works, and I believe they will now be supplied as fast as they are needed. Twenty-six are yet to be made.

Similar difficulties and delays were experienced in other parts of the steel works. About four-fifths of the entire steel required consists of tubes about thirteen feet long and eighteen inches in diameter. These are each composed of six staves of the length of the tube, and varying from one and one-eighth to two and one-eighth inches in thickness, and each being about one and one-half inches wide. Several attempts were made to roll these staves before the rolls were perfectly formed to accomplish it. Each failure necessitated the removal of the rolls from the mill for alteration to the machine shop, several miles distant. Each of these rolls weighed several tons, and this usually involved a loss of two or three weeks before they were in place again and ready for trial.

An option had been given the contractors to have these staves rolled with a rib on each edge of the stave and projecting into the tube, or to roll them without these ribs. The steel company elected to roll them with the ribs. After three or four alterations of the rolls they determined to abandon the attempt to roll them with the ribs. This involved the making of an entire new set of rolls, ten or twelve in number, and when these latter were tried they had to be twice or thrice returned to the machine shop before perfect staves could be turned out with them.

In this way at least six months were consumed before a stave could be offered for testing. When this was done the steel proved inferior. Repeated changes had then to be made in mixing the steel. When a satisfactory mixture was obtained it was only then discovered that the same degree of strength was not present in all the staves made from it. This was believed to result from a want of proper care in melting and in forging the ingots, and in second heating for rolling. No doubt the difference in the degrees of heat applied to the perfect and imperfect ones altered the proportions of carbon and iron, or their relations to each other, and thus caused a decided difference in the strength of the staves thus made from the same formula. Of the anchor-bolts about twenty or twenty-two which stood the test were carbon steel, while nearly an equal number failed under it, although many of the failing ones were made by the same formula as the good ones.

These results proved the absolute necessity of using the greatest skill and caution in the application of the requisite degrees of heat in making carbon steel. The want of this extraordinary care has caused great loss of time and money to the Bridge Company, and has doubtless occasioned serious loss to the Butcher Steel Works. This unfortunate experience induced that company to endeavor to find some other method which would insure with less skill and caution a greater uniformity of product. With this view, experiments were commenced at the works recently in making chrome steel under the patents of Mr. Bauer. These trials were under the direction of Mr. C. P. Haughian, Superintendent of the Chrome Steel Company, and were attended with the most satisfactory results. An arrangement has since been made with the patentee for manufacturing this steel.

Chromium unites with iron and forms an alloy, similar in its properties to steel. Chromium is quite different from carbon in some important particulars. It is a metal, while carbon is not. It has little or no affinity for oxygen, and is not affected by excessive heating, while carbon has a great affinity for it, and by the application of heat it is liable to be burned out of the steel.

One hundred trial staves were made last month of chrome-steel, under the directions and from the formula of Mr. Haughian. They were all beautifully and perfectly rolled, and there was no failure in any one of them to stand the test required. This steel comes from the rolls much more smoothly than the carbon-steel, and it works quite as easily; being capable of sustaining a greater degree of heat than the carbon-steel, it takes the form of the rolls more readily.

Tests made of this steel by me, before the contract was made with the Keystone Bridge Company, satisfied me that it possessed qualities eminently suited for the bridge superstructure.

In 1870 Mr. Haughian allowed me to be made acquainted with the entire process of manufacturing chrome-steel. Commodore J. W. King, of the engineer corps of the navy, now Chief of the bureau of Steam Engineering, kindly volunteered to investigate the subject for me, and on my personal pledge that Mr. Haughian's trade secrets should not be revealed, Commodore King and my Chief Assistant, Col. Flad, were allowed to pass forty-eight hours in the closest inspection of the works, during which time they weighed out the proper mixtures, placed them in the crucibles, melted them, cast the ingots and had the steel finished by the hammer, all being under their immediate supervision. An elaborate confidential report was afterward made by them to me of their observations and experience.

As it was, however, a patented manufacture, and made by but one establishment, to have required it to be furnished by my specifications would have been equivalent to compelling the Keystone Bridge Company (whose contract with your company was made before my specifications were complete) to forego all competition in obtaining the steel; and as several other makers expressed the fullest confidence in their ability to furnish an equally reliable steel, it seemed but fair to state the necessary qualities which the steel should possess, without prescribing any special formula that would restrict competition.

I did not feel justified in assuming that crucible carbon-steel of the qualities and forms required could not be readily made, when I was assured of the contrary by some of the most eminent steel-makers in America. I was so fortunate as to be permitted to make a careful personal examination of Mr. Krupp's great works in Prussia, and also the mammoth works of Messrs. Petit, Gaudet & Co., in France, and was also assured by the managers of both of them that our requirements were entirely practical with carbon-steel. I did not, however, hesitate at any time to express my belief that the chrome-steel was most likely to meet the requirements of the bridge; nor am I justified now, perhaps, even with the experience developed at the Butcher Steel Works, in asserting more than my opinion that carbon-steel cannot be made with as equal regularity and uniformity as the chrome-steel.

I think the sequel has proved that it was unfortunate for your interests that a contract for chrome-steel was not made at first, for the unsuccessful attempt to supply the carbon-steel for the bridge by the Wm. Butcher Works has seriously delayed its completion.

While this disappointment has resulted in a great loss to you by the delay it has involved, it must have inflicted serious damage upon the Wm. Butcher Company. The honorable disposition shown by the latter company to discharge the obligations of their contract with the Keystone Bridge Company, and furnish a quality of steel fully equal to their agreement, notwithstanding their many unexpected losses and disappointments, certainly merits your considerate notice. The President of the company, Mr. Samuel Huston, has repeatedly assured me of the determination of himself and associates to supply the bridge steel as promptly as possible; and that they ask no abatement in its quality, but were resolved to make it fully equal to the requirements of the contract, cost what it would.

Acting upon this commendable determination, that establishment has contracted to pay Mr. Haughian a royalty of $15,000 for the right to make chrome-steel for your bridge; and I have been assured by Mr. Huston that henceforth no other kind of steel but this would be made for it.

From what I know of the manufacture of chrome-steel, and from the tests of anchor-bolts, staves and envelope plate-steel, already made at the Wm. Butcher Works, from the formulas of Haughian, I feel every assurance that the difficulties in the way of supplying the steel for your bridge are now surmounted. The steel we are now testing is of a quality entirely satisfactory, and the workmanship is unexceptionable. The tests made of its ultimate tensile strength are considerably in excess of the specifications. In compression almost any degree of resistance can be obtained by the addition of chrome. To avoid unusual difficulty, however, in finishing the steel in the lathes, it is only made sufficiently hard to meet the requirements of the specifications.

In my report of last October (pages 8 and 36) I referred to the fact of a scour of fifty-five feet in vertical depth having occurred in the river bottom alongside of the east pier, and of the proofs that were met with in sinking that pier that the scour at times extended even to the rock itself. It was generally assumed by others who had studied the peculiarities of the river that the scour never extended deeper than thirty feet below low-water mark. Although I believed it extended much deeper, and that there would be no assurance of stability for the channel piers unless founded on the rock, I believed, when designing the bridge, that the abutment on the Illinois shore could be made safe on a pile foundation. The original estimates, therefore, only contemplated a foundation of this kind, with the base of the masonry starting from a level seventy feet above the bed-rock. The possibility of founding this abutment on the rock having been demonstrated by sinking the east channel pier, and the proofs of scour of the river bed to such extraordinary depths being perfectly conclusive, the board expressed the unanimous desire that this abutment should be founded on the rock. By an examination of the appendix it will be seen that the cost of this extra work was $232,626 64, no part of which was in the original estimate.

The original design of the bridge contemplated an upper roadway wholly of wood. The sub-structure of this roadway was designed to act as a truss to resist the action of hurricanes upon this part of the bridge. As now designed, this sub-structure or wind-truss will be in the form of a flat or horizontal girder fifty-four feet wide, extending from pier to pier, and formed entirely of plate-iron, thus giving much greater security against wind, and furnishing a fire-proof defense for the upper roadway against the sparks and heat from the engines when passing on the railways below. The wonderful force exerted by the tornado last March, which was so destructive in its effects upon the construction works of the bridge company, leaves no question as to the propriety of this change. Nothing equaling the power of this storm is believed to be on record. A locomotive of over twenty-five tons weight was actually hurled from the rails by it and was thrown over on its side twenty-five or thirty feet from the track, on ground only four or five feet lower than the rails. No evidence of the engine disturbing the rails, or of touching the earth within twelve or fifteen feet of the track, could be discovered. These facts were reported to me by my chief assistant, Col. Henry Flad, who personally inspected the spot immediately after the storm.

From calculations based upon the data furnished by this tornado, I feel confident in asserting that the arches of the bridge will be capable of resisting an equally powerful tempest. The extra cost involved in substituting this plate-iron wind-truss for the wooden one will be $80,000.

The destruction of machinery, scaffolding, &c., caused by the tornado, with incidental expenses caused by it, cost the company fully $50,000.

The original estimate contemplated an extreme width of fifty feet for the bridge. This has been increased to fifty-four feet two inches. Several reasons made this change desirable, if not absolutely necessary. By the increased width twelve inches of additional space between the arches are obtained for each railway track. This is believed to be an important improvement, and one which was rendered desirable from the increased width given to the Pullman palace cars since the original design of the bridge was made in 1867.

On the upper roadway the local traffic will be more conveniently accommodated by this change. Two lines of horse railway cars are provided for on it, with room on either side of them for the largest transfer wagons. The sidewalks will be nine feet wide instead of eight. In addition to these desirable advantages, the general appearance of the structure will be considerably improved. The most important consideration, however, in determining upon this modification in design, was the increased security afforded by it against violent winds.

The extra cost of widening the bridge four feet and two inches is estimated at $127,652, and the additional land damages at $30,000.

Some compensation for the disappointment that must necessarily result from the delay in completing the structure, and from its increased cost over the original estimates, may be found in the fact that the estimated amounts of traffic upon which the revenues of the bridge were predicated in 1868, have been ascertained after a careful examination of actual facts and figures in 1870, by Mr. William Taussig, Chairman of the Executive Committee, to be greatly under-estimated. It is confidently believed, from facts developed by this examination, that the income of the bridge will be very largely in excess of the amount estimated in 1868.

With respect to the work remaining to be done, I do not think there can be a possibility of the actual cost differing materially from the estimates henceforth. It is all under contract, and the weights and amounts have been very carefully verified. I feel quite confident that the delay in the superstructure, which has retarded the entire work, and added very considerably to the expenses already incurred, is fast drawing to a close, and that before many more weeks we will see some of it in the course of erection.

The character of the work, as far as it is finished, is unsurpassed in excellence and solidity by anything in this or any other country. When finally completed, I feel confident that the magnitude of the structure, the superiority of the workmanship, and the qualities of materials used, will fully justify the total cost of its erection, and that its revenues will amply compensate for the investment.

When all of the many difficulties that have retarded this great work shall have at last been surmounted, and the bridge becomes an accomplished fact, it will be found unequaled in the important qualities of strength, durability, capacity and magnitude, by any similar structure in the world. Its great usefulness, undoubted safety and beautiful proportions, will constitute it a national pride, entitling those through whose individual wealth it has been created to the respect of their fellow-men; while its imperishable construction will convey to future ages a noble record of the enterprise and intelligence which mark the present times.

JAMES B. EADS,
Chief Engineer.

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—Miss S. Emma Price calculated and arranged the strain sheet for a span 228 feet long of the International Bridge, and the span has been constructed accordingly by the Phœnix Iron Company, which has Miss Price in its employ.

## Organization of the New Jersey Railroads under the Pennsylvania Railroad Company.

The following general orders give the organization of the New Jersey railroads as they are now operated by the Pennsylvania Railroad Company.

The following is from J. Edgar Thomson, President of the Pennsylvania Railroad Company, and is dated December 8:

The duties of the General Superintendent of the Pennsylvania Railroad have been extended over the railroads recently leased from the United Railroad Companies of New Jersey, and his title has been changed to that of General Manager. His office will be at Philadelphia from and after this date.

Under date of December 9, President Thomson issued the following general notice:

The organization of the Pennsylvania Railroad Company having been extended over the railroads, canal, property and interests of the United Canal and Railroad Companies of New Jersey, and the Philadelphia & Trenton Railroad Company, mentioned in the lease thereof to the Pennsylvania Railroad Company, the instructions and orders of the following officers of the Pennsylvania Railroad Company will be respected and obeyed by the agents and employes thereon: Thomas T. Firth, Treasurer; A. J. Cassatt, General Manager; Samuel G. Lewis, Controller; S. B. Kingston, General Freight Agent; Henry W. Gwinner, General Passenger and Ticket Agent; W. J. Howard, General Solicitor.

The following general order of General Manager Cassatt, December 16, establishes the title under which the New Jersey lines will be operated, and names its superintendent:

The following lines of railroad, which came under the control of the Pennsylvania Railroad Company by the lease of the United Railroads of New Jersey and the Philadelphia & Trenton Railroad, will constitute a Division to be known as the "United Railroads of New Jersey Division," viz.:

The Camden & Amboy Railroad with the branches extending from Bordentown to Trenton, from Jamesburg to Monmouth Junction, from Monmouth Junction to Kingston and the Princeton Branch, the Philadelphia & Trenton Railroad, the New Jersey Railroad, the Perth Amboy & Woodbridge Railroad, the Millstone & New Brunswick Railroad, the Rocky Hill & Kingston Railroad, the Frankford & Holmesburg Railroad, the Connecting Railway, the Pemberton & Hightstown Railroad, the Burlington & Mount Holly Railroad with the Medford Branch, the Camden & Burlington County Railroad, the Vincentown Branch, together with the ferries between Jersey City and New York, the freight and passenger boats running between Walnut Street Wharf, Philadelphia, and Camden, and the boats engaged in the transportation of passengers and freight between South Amboy and New York, and Jersey City and New York.

This division will be in charge of a General Superintendent, who will exercise on his division all the authority conferred by the organization upon the General Manager of the Pennsylvania Railroad, and who will report to and receive his instructions from the General Manager of the Pennsylvania Railroad.

F. Wolcott Jackson has been appointed General Superintendent of the United Railroads of New Jersey Division. His office will be at Jersey City.

The duties of Isaac Dripps, Superintendent of Motive Power and Machinery of the Pennsylvania Railroad; Theodore I. Heizmann, Engineer of Maintenance of Way of the Pennsylvania Railroad; Enoch Lewis, Purchasing Agent of the Pennsylvania Railroad, and of Samuel Carpenter, General Baggage Agent of the Pennsylvania Railroad, have been extended over the United Railroads of New Jersey Division.

The duties of C. E. Pugh, General Agent of the Pennsylvania Railroad at Philadelphia, have been extended over the passenger and freight depots of the United Railroads of New Jersey Division in Philadelphia.

To take effect December 21, 1871.

F. Wolcott Jackson, appointed General Superintendent of the United Railroads of New Jersey Division, by the above order, establishes the divisions of these lines and appoints their chief operating officers by the following "General Order No. 1," dated December 18:

The United Railroads of New Jersey Division will be subdivided into two divisions, viz.:

The New York Division, extending from Philadelphia to Jersey City, and including the Frankford & Holmesburg Branch, the Princeton Branch, the Rocky Hill & Kingston Branch, the Millstone & New Brunswick Branch and the Perth Amboy Branch.

The Amboy Division, extending from Amboy to Camden, including the Pemberton & Hightstown Railroad, the Camden & Burlington County Railroad, the Vincentown & Medford Branches, the Burlington & Mount Holly Railroad, and the branches extending from Bordentown to Trenton, and from Jamesburg to Monmouth Junction, and including the boats engaged in the transportation of passengers and freight between Walnut Street Wharf, Philadelphia, and Camden.

The New York Division and the Amboy Division will each be in charge of a Division Superintendent, who will exercise on their respective divisions the powers and authority conferred by the organization upon the division superintendents of the Pennsylvania Railroad, and who will report to and receive their instructions from the General Superintendent of the United Railroads of New Jersey Division.

George W. Barker has been appointed Superintendent of the New York Division. His office will be at Jersey City.

Isaac S. Buckalew has been appointed Superintendent of the Amboy Division. His office will be at Trenton.

George D. Howell has been appointed Principal Assistant Engineer of Maintenance of Way of the United Railroads of New Jersey Division. He will assist the General Superintendent in such duties connected with the maintenance of way department as may be assigned to him.

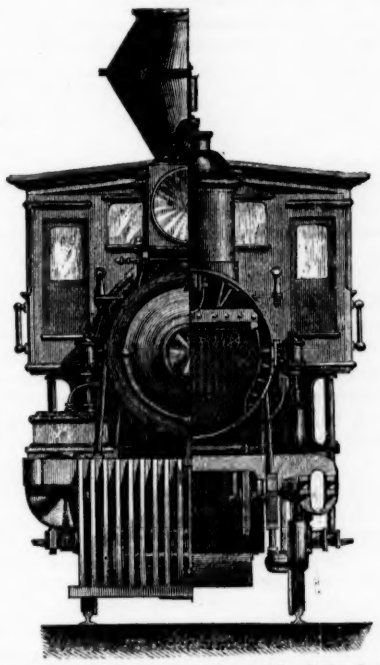
Robert Stewart has been appointed Superintendent of Telegraph of United Railroads of New Jersey Division. He will have charge of all the lines of telegraph upon this division, subject to the order of the respective division superintendents; and in addition thereto, will assist the General Superintendent in such duties as he may assign to him.

C. S. Gauntt has been appointed Car Agent of the United Railroads of New Jersey Division, and will have charge of the distribution of all freight and passenger cars, including the numbering, weighing and recording thereof. His office will be at Trenton.

Captain Charles A. Woolsey has been appointed Superintendent of Ferries, and will have charge of the boats engaged in the transportation of freight and passengers between Jersey City and New York, and South Amboy and New York.

To take effect December 21st, 1871.

## End View and Cross Section of the Baldwin Locomotive.



This engraving represents one-half of the front end, and a half section about the center of the engine of which we published an elevation and longitudinal section last week. The engraving will explain itself, and shows the construction of some parts which could not be clearly represented by the other views.

## Liquid Fuel.

The report of the Coal Commission contains an exhaustive paper, by Dr. B. H. Paul, upon this subject. The materials which have been proposed for use as liquid fuel are petroleum in a crude state; crude paraffine oil, obtained by the distillation of cannel coal or of bituminous shale; the heavy oil separated from these materials; waste products of the manufacture of burning oil, etc., from petroleum and paraffine oil; and dead oil, or creosote. All these materials agree in consisting essentially of mixtures of certain oils, composed of carbon and hydrogen, hence termed hydrocarbons. The oils do not vary much in the relative proportions of their constituent elements, but chiefly in their degrees of volatility and density. The average space occupied in stowing is by crude petroleum 43.41 cubic feet per ton; crude paraffine oil, or heavy oil from either, 40.93 cubic feet per ton; dead oil or creosote, 34.25 cubic feet per ton; and coal, 40.20 cubic feet per ton. All these materials are much more inflammable than coal. This is especially the case with crude petroleum and crude paraffine oil, both of which contain a considerable amount of very volatile spirit, or oil, that will take fire at and below the ordinary atmospheric temperature on contact with flame, and will also give off vapor that is readily inflammable, and when mixed with air becomes explosive. But the oil from which this more volatile portion has been separated will bear being considerably heated without taking fire by contact with flame. The dead oil from the coal-tar of gasworks will bear being still more strongly heated before it will take fire, and it is scarcely capable of giving off inflammable vapor. In this respect, therefore, its use as fuel is attended with less liability to accident by fire than any of the other materials proposed to be used as liquid fuel.

The relative calorific power and evaporation efficacy of these materials and of coal or other kinds of fuel can be estimated according to their chemical composition, and a comparative statement of the results obtained by such an estimate shows the heat generated and available to be by crude petroleum, crude paraffine oil, or heavy oil, from either, 20,000 units, of which 16,847 are available for producing steam; by dead oil or creosote, 16,628 units are generated, of which 14,567 units are available for producing steam; and by coal 14,361 units are generated, of which 10,409 are available for producing steam. These figures represent the evaporation of 15 lb., 13 lb., and 9·31 lb. of water respectively for each 1 lb. of fuel consumed. The steam-producing capabilities of the liquid fuel is, therefore, from 53 to 68 per cent. higher than coal, so that the saving of stowage space with liquid fuel would be less by 35 or 40 per cent. than that required for coal or equal steam-producing capability. One of the applications of liquid fuel first attempted was for generating steam.

With regard to the danger of using liquid fuel, Dr Paul remarks that it must be remembered that crude petroleum and crude paraffine oil are both highly inflammable, even in the cold; that they both readily give off an extremely inflammable and very diffusive vapor, especially when slightly warmed; and that this vapor, when mixed with atmospheric air in certain proportions, becomes violently explosive on contact with flame or with any body sufficiently heated. These materials likewise possess a great capability of penetrating through extremely small apertures, and therefore they would be liable to escape from any defect in the tanks containing them, and thus, by coming in contact with atmospheric air in confined spaces, to form an explosive mixture that might endanger the safety of a vessel; he also refers to the danger to be apprehended from the liquid itself taking fire. The only known material of this class that is free from the objections that may reasonably be urged against the adoption of either petroleum or paraffine oil in the crude state, or the less volatile portions of them, is the dead oil or creosote obtained as a waste product from coal-tar.

The prospects moreover of a supply of materials applicable as liquid fuel at a price that would permit of its use are anything but reassuring. The total production of petroleum in America does not amount to more than about 400,000 tons a year, and the demand for it for lighting and lubricating is rapidly increasing. No other source of petroleum is known which at all approximates in extent to that in America, but even that appears trifling when compared with the enormous consumption of coal for steam navigation—upwards of 10,000,000 tons a year. The present price of creosote is 22s. per ton, f. o. b. in the Thames. Dr. Paul mentions too that all the liquid fuels possess a strong, penetrating, and to many persons disagreeable smell, which becomes much more perceptible when the oil is in contact with heated objects, even in very small quantity. Hence, in the use of any of these materials as fuel a slight leakage of the reservoirs or conducing pipes, and the almost unavoidable presence of small quantities of the oil spilt or smeared about the stoke-hole of a steam-vessel, would be likely to diffuse throughout the whole vessel a smell which might be considered highly objectionable, especially in passenger ships. Giving full weight to the various advantages capable of being gained by the use of liquid fuel, and considering the various circumstances of cost, extent of supply, etc., which would affect its applicability, Dr. Paul concludes that the use of fuel for steam navigation purposes must in any case be very limited, and that it is only under special conditions that it would be desirable. But liquid fuel when burned with a blast affords the same advantages as the gas furnace introduced by Mr. Siemens, and for this reason it appears to be likely that its application in this way for heating iron plates, forging, etc., would be attended with considerable advantage in ironworks.—*The English Mechanic.*

## Atlanta and West Point Railroad Report.

In the report for the year ending June 30, 1871, the Superintendent says: "For eight months ending February 28, the general business had increased over the same period of the previous year, $17,410 83; while there was a decrease for the last four months of $31,652 02, and consequently a total decrease in the business for the whole year of $14 241 10." The particulars of this reduction in gross earnings will be seen from the following comparative statement:

| Gross earnings. | 1870. | 1871. |
|---|---|---|
| From passengers | $151,358 07 | $14 ,300 65 |
| " freight | 296 700 38 | 295,111 77 |
| " mail | 8,649 96 | 8 649 96 |
| " express | 9,105 40 | 8,643 83 |
| " U. S. Government securities | 2,082 77 | 1,099 18 |
| Total | $467,956 58 | $463,715 89 |
| Ordinary expenses: | | |
| Conducting transportation | $69,715 55 | $75 495 76 |
| Motive power | 96,477 01 | 92,654 74 |
| Maintenance of way | 82,936 56 | 75,748 48 |
| Repairs of cars | 19,040 23 | 20,361 92 |
| Taxes, &c. | 7,100 00 | 3,441 27 |
| Total | $275,898 35 | $267,704 67 |
| Extraordinary expenses: | | |
| New locomotives | $27,0 0 00 | $36 000 00 |
| New cars | 6,000 00 | 15,000 00 |
| New iron | 20,000 00 | 15 000 00 |
| New depots, &c. | ..... | 22,000 00 |
| Total | $53 000 00 | $88,000 00 |
| Total expenses | $328 898 35 | $355 704 67 |
| Net earnings | 139,058 23 | 98,010 72 |

The ratio of ordinary expenses to earnings was about 59 per cent. The financial condition of this company compares very favorably with that of other roads; and it is evident, from the general balance sheet, in which the capital stock and bonded debt is quoted at $1,259,000, (or not quite $15 000 per mile of road), that the strictest economy must have been practiced in its original construction; that the directors and active managers must always have had in view the permanent interests of their constituents, and that a sufficient revenue can always be derived from local business to pay a good dividend upon the investment.

This railway extends from Atlanta, Ga., southwest 86¼ miles to West Point, Ga., on the Alabama line. It is of five feet gauge, like nearly all the other railroads in the Gulf States, and has rails weighing fifty pounds per yard. It is a good example of a cheap railroad, similar to many others in the South, in situations where, probably, a more costly and better line would be unprofitable. The rolling stock one year previous to this report consisted of 16 locomotives, 6 passenger cars, 6 baggage, mail and express cars, 61 box cars, 18 stock cars, and 25 platform cars.

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## Editorial Announcements.

*Address.*—*The* RAILROAD GAZETTE *will be printed for the present in New York; our printing house in Chicago having been destroyed. All communications, therefore, whether editorial or business, should be directed to the New York office. The proprietor will receive subscriptions and advertisements at his office in Chicago, Nos. 63 and 65 South Canal street, but letters should be addressed to New York.*

*Correspondence.*—*We cordially invite the co operation of the railroad public in affording us the material for a thorough and worthy railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.*

*Articles.*—*We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.*

*Inventions.*—*No charge is made for publishing descriptions of what we consider important and interesting improvements in railroad machinery, rolling stock, etc.; but when engravings are necessary the inventor must supply them.*

*Advertisements.*—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay.* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

## THE TRANSIT QUESTION IN NEW YORK.

New York is occupied at present with its annual excitement on the question of the means of travel from one end of the city to the other. All who are at all familiar with the geography of Manhattan Island know that it is long and comparatively narrow—the length being about ten miles and the width two. As population has advanced toward the upper end of it, the current of travel has of course grown each year with the increase of population; and furnishing adequate means of transportation for the immense numbers of people who must go to and from their business each day is a problem of increasing difficulty each year, and it has now become evident that the area available for the residences of men actively engaged in business must be confined to that portion of the city below Central Park, unless some more rapid means of getting to and from the district above is provided. It is also evident that the value of property, both at the upper end of the island and north of Harlem River, would be very much enhanced if some means were furnished by which those who live in these districts could go to and from their places of business in less time than is now required. It is therefore obvious that it is very much to the interest of property-holders in those sections that some such means should be furnished. It is also plain that if the section above Central Park were made as accessible as that which is now within the area of high rents, the latter would be very much reduced by such an outlet. Quite naturally, therefore, those who have houses to rent in the lower half of the island are opposed to all projects which promise the means of more rapid transit to and from the extreme upper part. In league with the latter are all existing horse-railroad and omnibus companies. The clamor, therefore, on both sides, is becoming very earnest. The one party, animated by the prospect of gain from the increase in value of their property; the other fearful of a loss in their receipts. Nearly every man, woman and child in the city feels a personal interest in the question, and every business man, unless possessed with the patience of Job or the piety of a saint, growls in the morning and is profane in the evening at the insufficient and utterly inadequate accommodations furnished by the horse railroads.

There are two or three rival companies, with pet schemes for solving the difficulty, which they are carefully nursing, and loudly calling on the public to admire and adopt. To add to the complications of the question, Mr. Vanderbilt has built his immense depot on Forty-second street, and turned the traffic of three railroads into one of the main avenues of the upper end of the city, thus bisecting it, and making communication from one side to the other difficult and dangerous. Numbers of people have been killed and maimed, and the noise along the line of the road has made the section of city bordering on it, if not uninhabitable, at least sufficiently uncomfortable to depreciate very seriously the value of property in that part of the city. The trains—of which there are a great many—are run across the streets at the level of the latter, with a regard for human life hardly greater than would be shown if the road was located on a Western prairie. Quite naturally the property-holders are clamorous for some mitigation of the evil, and it seems to be conceded that the location of the depot and its approaches was a great blunder. Of course under all these circumstances a solution of the difficulties becomes an engineering problem of very great importance, and one in which the services of the ablest men in the profession should be enlisted, which, we regret to say, does not seem at all probable; but upon the contrary it is now in the hands of contending factions whose deliberations have often more the character of a political caucus than of scientific investigation. The next session of the Legislature will probably be the battle-field, and as indications now are, it seems probable that the leading railroads which enter New York have become interested parties in one of the schemes, so that if there is a contest this winter, those who engage in it must marshal strong forces.

Of course immense diversity of opinion exists in relation to the whole subject, and almost any man you meet in New York has very decided opinions in favor of or opposed to elevated, subterranean or depressed roads. Such opinions are of course generally based on mere rumors, prejudice or personal interest; and it is safe to say that very little accurate knowledge exists in relation to the subject. Inasmuch as some *system* of rapid communication and travel from one end of the island to the other is a vital necessity, and one to which a great many collateral interests attach; and considering the want of accessible information, the wisest plan altogether would seem to be the appointment of a commission, consisting of some of our ablest engineers, capitalists, property-holders and a lawyer or two, to systematize the inquiries, with authority to take evidence, make surveys and "send for persons and papers," and, in fact, make an exhaustive report on the subject, and make it and all the evidence upon which it is based accessible to the public. The organization of such a commission would, of course, be attended with political dangers; but probably the appointing power could be most safely lodged in the hands of the Governor. Such an investigation would, of course, require considerable time, which would be fully justified by its importance. In such a matter as this, which involves the welfare of hundreds of thousands, doubtless of millions in the future, and affects the value of millions of property, too much pains cannot be taken, not merely to select a feasible plan, but the best one. Indeed, its very execution depends chiefly upon its excellence. Just so soon as it has made reasonably certain that a city railroad on a certain plan will be profitable, it will be easy to obtain all the money, however great the amount, needed to execute it. The owners of land in the upper part of the island and in Westchester county alone could well afford to pay for a road which will carry passengers from Harlem Bridge to the City Hall in half an hour. With it Harlem would be as accessible as Twenty-third street, and Yonkers easier to reach than Central Park. And the effect of such a road would have advantages for the residents of the lower part of the city, even if it should not be used by them. It would be a constant competitor with the horse railroads, and would compel them to increase their accommodations, and offer some inducements to passengers, which they can hardly be said to do now.

### The New York Central & Hudson River Railroad.

Although it is so long since the consolidation of the New York Central and the Hudson River companies, their organizations for operation have been maintained about as distinct as before. Now, however, changes are made to secure greater unity and simplicity in the operation of the combined lines. There is no appointment of a general superintendent, but the Vice President, William H. Vanderbilt, acts as General Manager, and Mr. J. M. Toucey, as heretofore, is Superintendent of the line between New York and Albany, and Mr. J. Tillinghast of the lines and branches west of Albany, the latter having three assistant superintendents. Mr. Augustus Schell resigns the office of Secretary and Mr. Edwin D. Worcester, long Treasurer of the New York Central, takes his place; while Mr. Charles C. Clarke, for many years Treasurer of the Hudson River Company, is made Treasurer of the New York Central & Hudson River Company. Mr. Henry R. Pierson, formerly manager of Brooklyn railroads, and afterward Vice-President of the Chicago & Northwestern, a gentleman of fine ability and the most perfect fidelity, is to reside in Albany as Managing Director, where also will remain Mr. Utter, Comptroller of Real Estate, Rents and Taxes.

### Cotton and Grain as Affected by the Cost of Transportation.

The cotton crop of 1870—the largest in the United States since the war—amounted to 4,352,317 bales, and weighed 2,021,651,000 pounds. This is equivalent in weight to 33,684,183 bushels of wheat, or 36,000,900 bushels of corn. Now, the receipts of grain at the seven principal primary receiving depots in the United States in that part of the year ending December 16, 1871, amounted to 49,177,175 bushels of wheat and 56,556,972 bushels of corn; so that, to the transporting interest, either the wheat or the corn crop is seen to yield 50 per cent. more business than the cotton crop. And in this case the figures do not tell the whole truth.

We have made the comparisons only with the grain received at some of the primary depots in the country, while taking the entire crop of cotton. Now, it would be unfair to compare the entire grain crop with the cotton crop in any estimate which has to do with the relative importance of the two to the transporting interest; for almost every bale of cotton raised is not only shipped, but shipped a considerable distance, while the largest part of the corn crop, and probably of the wheat crop also, is consumed where it is grown, or so near that it requires no transportation by rail or water. Still it is evident that a very large amount of the grain shipped in the United States never reaches any of the places whose receipts are given above. Nearly all that shipped through by rail from the place of production to that of consumption is excluded, and a very large amount transported for domestic consumption.

This may serve to show why the South cannot support so many miles of railroad according to its area as the North, and not even so many in proportion to population. However valuable may be the product of the labor of one man in the cotton region, it is not nearly so heavy as that of one man in a grain-growing country. This is an advantage to the Southern farmer, for it makes the transportation tax on his produce much lighter than that on the grain-grower. The latter must pay for the transportation of perhaps 140,000 pounds of corn, for which he receives at the lake port $1,000, while on the former's cotton, bringing an equal amount in port, he has to pay freight for only about 5,600 pounds—the cotton bringing 18 cents and the corn but ¼ of one cent per pound. On wheat the transportation tax is not so formidable, as it is worth (just now) about three times as much as corn. But the cost of transportation of it and of all grain forms a very large percentage of their cost to most consumers, and is the greatest obstacle to the success of settlers in the grain districts of the Far West.

### Some Economical Results of Cheap Transportation.

Any improvements which shall result in a very great reduction in the cost of transportation in this country, and in the North especially, will probably be followed by some economic changes of widespread effect. First, doubtless, the cost of food in the Old World and the East would be materially decreased, and the profits of the Western farmer considerably increased. There might be expected, then, a reduction in the cost of European manufactured goods, a large increase in the production of grain in the Northwest and a decrease in Europe, and a greater difficulty in competing with European manufacturers in America and especially in the West. But unless such decrease in the cost of transportation should apply to the ocean voyage as well as to rail, which is not to be expected, the cost of food would be affected more proportionately in the Eastern States than in Europe, and the manufacturers of these States would have less than ever to fear from competition in the West. The cost of food would be less to his laborers and greater

to those of his Western competitor than now, and so with all Western products used in manufacturing. The cost of transportation is the great protective tariff of this country, but it is one that protects the West as against the East more than America as against Europe. It is a tax, however, which the West will very cheerfully spare, though probably some of its manufacturers would regret it after its disappearance.

Of course these remarks apply only to such manufactures as work up Western products chiefly. In so far as they depend upon materials imported from the East or upon the supply of Eastern consumers, they would be benefited equally with the farmers.

### The Financial Condition of the Union Pacific.

Messrs. Morton, Bliss & Co., the financial agents of this company, have recently issued a statement concerning the financial condition of the road and its earnings since completion. The bonded debt is given as $46,528,000, consisting of first-mortgage, land-grant and income bonds; the second mortgage bonds guaranteed by the United States, which pays the interest on them, amount to $27,236,512, and the capital stock to $36,745,000. This makes the total capital account of the company $110,509,512, which is at the rate of $106,361 per mile. The company is compelled to reserve 5 per cent. of its net earnings and one-half of its receipts for government transportation to apply on the principal and interest of the bonds guaranteed by the government. The remainder of the bonded debt, for which it alone is liable, amounts to $46,528,000, the annual interest on which in currency is $3,431,670 (counting the premium on gold 9 per cent.)

The following is the statement of earnings since the opening of the road :

| | |
|---|---|
| *First Fiscal Year, May 10, 1869, to April 30, 1870.* | |
| Gross earnings | $8,364,592 50 |
| Expenses | 5,797,998 56 |
| Net earnings | $2,567,493 94 |
| Percentage of expenses, 69 30-100. | |
| *Second Fiscal Year, May 1, 1870, to April 30, 1871.* | |
| Gross earnings | $7,333,961 35 |
| Expenses | 3,898,704 26 |
| Net earnings | $3,435,257 09 |
| Percentage of expenses, 53 16-100. | |
| *First Six Months of Third Fiscal Year, May 1, 1871, to Oct. 31, 1871.* | |
| Gross earnings | $4,385,964 20 |
| Expenses | 1,935,744 26 |
| Net earnings for six months | $2,450,219 94 |
| Percentage of expenses, 44 13-100. | |

At this rate it is seen that the earnings for the year will amount to about $4,900,000—nearly $1,500,000 in excess of the amount required for the interest on the bonded debt aside from the second mortgage, and nearly sufficient to pay this also.

Up to that date the company had sold 480,141 acres of land at an average price of $4.23 cents per acre, and had remaining 11,599,859 acres. The average value of the latter, of course, must be very much less than that of the former, which includes only fertile land in the most desirable places, while a very large part of the land grant is quite barren. However, at the rate of only 72 cents per acre the land would suffice to redeem all the land grant bonds.

## NEW PUBLICATIONS.

*Travels in the United States of America.*—A report to the Minister of Public Works of Belgium has been made recently by Mr. Gustave Schorn, Engineer of the Mines of the State. This report of 132 pages, with six sheets of plates, written by a young Belgian engineer, who visited this country in 1869, by direction of his government, contains a very complete review of the American system of railways. It treats of the establishment of railway companies; the earliest construction of our railways; the present length of lines in the several grand divisions of the Union; their characteristics as to grades, alignment, gauge, etc.; the features of the rolling-stock, in which it differs from European practice; the service obtained from locomotives and tires, coaches and freight wagons, and the cost of each; of the roadway and works, the varieties of rails and joints, the bridges, stations and fences; and, last, of the administration of these railways, in a brief, clear style, showing a perfect understanding of the topics, and a scientific habit of mind.

To well-informed American railroad men there would, of course, be little that is new in this report, although many particulars are here grouped not to be found together elsewhere; but, for the use of British or Continental engineers who desire a clear idea of the American system, we know of no volume to be compared with this; and, as it is written in the French language, it will be open to a larger number of persons than if written in any other European tongue.

The following quotation, regarding our ways and works, accords with the views which we have long entertained, and we are, therefore, well pleased to print it, for the satisfaction of national pride, which is admirable so far as it is just, and to show the candor of the writer:

"It is generally admitted, even in the United States, that the construction of the railways in that country leaves much to be desired, and that travelers find there less security than in Europe, because of the haste and want of care in the building of the roads. I think this criticism may have been well founded, respecting many railroads, in the first years of their existence; the lines to be built had a considerable length, and required, even for their hasty construction, an enormous capital, especially when regard is had to the population of the country; and, finally, the people were anxious to enter upon the enjoyment of the railways, of which the utility was perfectly appreciated. Since then, as traffic has become developed, these iron roads have been constantly improved, curves of short radius have disappeared, or are in course of removal; heavier rails are employed and of a better quality; and to-day the greater number of the important lines have nothing to envy, in respect to solidity, upon the best lines of Europe."

### The Atchison, Topeka & Santa Fe Railroad Company.

We have received from one of the officers of this railroad company, which is likely to be one of the most important in Kansas, the following account of the condition and prospects of the company's property, which will serve for most purposes as well as an annual report :

The Atchison, Topeka & Santo Fe Railroad Company was incorporated by an act of the Legislative Assembly of the Territory of Kansas, approved February 11, 1859. By an act of Congress, approved March 3, 1863, a grant of land was made by the general government to the State of Kansas to aid in the construction of certain railroads in the State.

By an act of the Legislature of the State of Kansas, approved February 9, 1864, the State accepted the grant of lands made by Congress, and provided for their distribution. Section 3 of this act grants to the Atchison, Topeka & Santa Fe Railroad Company, in consideration of its constructing a railroad from Atchison *via* Topeka to the west line of the State in the general direction of Santa Fe, ten sections of land per mile of road construction, which grant was accepted by the company and the proper certificates filed.

The organization was maintained, but work was not commenced until 1863.

In September, 1868, the franchises passed into the hands of the present stockholders, and work was opened in October, 1868.

Various considerations induced the company to commence constructing from Topeka south, and August 1, 1870, the road was opened to Emporia, 62 miles.

Work was continued, and July 17, 1871, the road was completed up the Cottonwood River to Newton, 74 miles west of Emporia and 136 miles from Topeka.

On completion of the road to Newton, work was opened on the section between Topeka and Atchison, and at present writing grading and masonry is all completed, bridges all erected and about seven miles of track laid.

This part of the road was to have been opened January 1, 1872, but for an unfortunate failure of contractors to deliver iron on time. It was purchased for October and November delivery. Iron is now arriving daily, and the road will be opened to Atchison about March 1, 1872.

Contracts have been let for grading and masonry of a section, 115 miles long, from Newton up the valley of the Arkansas River to Fort Larned, to be ready for track March 1, 1872, and a large number of men and teams are now employed thereon. The cross-ties are purchased for delivery on or before March 1, 1872. It is designed to open this section for business by July 1, 1872.

This company is also building a branch road from Newton to Wichita, 25 miles south, which is to be ready for ties and iron January 1, 1872, and will be opened early in the spring.

The line now in operation, 136 miles from Topeka to Newton, passes through Osage, Lyon, Chase, Marion and Sedgwick counties.

The equipment consists of 15 engines, 13 coaches, 6 baggage cars, 22 box cars, 100 stock cars, 100 combination cars, 42 platform cars, 94 coal cars and 4 caboose cars.

During the current year there has been constructed and ironed 74 miles of road, and erected 1 machine shop, 1 oil house, 1 carpenter shop, 2 engine houses, 4 depots, 2 frame buildings of 5 rooms each for section men, 1 hotel at Newton, 8 tool houses, 8 water stations with stone foundations and tanks inclosed, and stock yards at 4 stations, those at Newton capable of yarding 6,000 cattle, with facilities for loading 6 cars at one time.

During the current year there has been added to the equipment 8 engines, 8 coaches, 4 baggage cars, 100 stock cars, 100 combination cars, 10 box cars, 50 coal cars, and 4 cabooses.

The located line west of Newton passes through Sedgwick, Reno, Rice, Barton, Stafford, Pawnee, Kiowa and Ford counties to Fort Dodge, west of which point counties are not organized. The present connections are the Kansas Pacific Railway at Topeka and the Missouri, Kansas & Texas Railway at Emporia. When opened to Atchison it will have connection at Grasshopper Falls with the Kansas Central Railway (narrow gauge), at Pawnee with the Union Pacific Central Branch, and at Atchison with the Missouri Pacific, Kansas City, St. Joseph & Council Bluffs and Atchison & Nebraska railroads, now in operation, and the Chicago, Rock Island & Pacific (Southwestern Branch) proposed to be opened in the spring. These companies are uniting for the purpose of building a railroad bridge over the Missouri at Atchison, and negotiations now pending promise its erection during 1872.

The construction of the Atchison, Topeka & Santa Fe Railroad is first class—wide road-bed, with first-class masonry at all openings; bridge superstructures, Howe truss, with iron bottom chords; track of best English 56-lb. rails, with fish-joints; water stations all with stone foundations and tanks inclosed, and each provided with a No. 1 wind-mill. The depots are all substantial frame buildings of neat design, well finished and painted. The construction has all been under the immediate supervision of T. J. Peter, Chief Engineer and General Manager, who enjoys the reputation of building some of the best railroads west of the Mississippi.

This is one of the most valuable franchises in the country. As evidence of its appreciation in Boston it is only necessary to say that the subscription of two and one-quarter million dollars to build the section of road west of Newton was all taken inside of three weeks, and *that* when the money market was unsettled by the Chicago fire. Aside from its magnificent land grant, it passes the full length of the State through the best agricultural and grazing districts in Kansas.

From Atchison, the second if not the first city in the State, it passes through the oldest farmed district in the State, abundantly supplied with wood, water and stone, connecting it with the capital city.

From Topeka to Emporia it passes through magnificent rolling prairies, now being rapidly settled and improved; also through the extensive coal-fields which now furnish transportation for a special coal train, although but partially developed.

From Emporia the line follows the fertile and well-farmed valley of the Cottonwood River to Newton. From Newton the line passes through a fine prairie, crossing the Little Arkansas River, and reaches the Arkansas River at Hutchinson, on Cow River, and follows the broad and fertile valley of that stream to the west line of the State.

General H. J. Strictler, President of the Kansas State Agricultural Society, one of the most eminent agriculturists and horticulturists in the West, who has resided in this State seventeen years, has just returned from an extended exploring expedition up this valley and into Indian Territory.

In a report of his expedition, he speaks of this valley as follows :

"The valley of the Arkansas above Fort Larned and below Fort Dodge is as fertile, as well drained, lying as well and capable of producing as good crops, as that portion lying between Fort Larned and Walnut Creek. All the elements of successful husbandry here dominate, except the supply of timber, which is scarce. I think the Arkansas Valley will be the most densely settled and richest agricultural producing district in Kansas in ten years."

The development of this immense valley will be the great work of this company. It will acquire over 2,000,000 acres of land in this magnificent valley, which will be sold to actual settlers at reasonable prices, and on terms the most liberal ever offered—being on eleven years' time, with 7 per cent. on deferred payments, with premium for improvements equal to a discount of 22½ per cent. of purchase money for cultivation of one-fifth of land purchased.

That large tracts of land may not pass into the hands of speculators, and thus retard settlements, but one section of land will be sold to the same party.

The even numbered sections still belong to the Government, and are open for pre-emption or homesteading, and immigrants can secure farms of unsurpassed fertility by merely occupying them.

The same facilities will be offered in the way of immigrant rates on passengers and freight to all, whether occupying Government or railroad lands. The policy will be to encourage by low rates the speedy settlement of lands adjacent to the road, and the lands are being rapidly taken. The abundance of coal found on the line of the road, and which is being transported at two cents per mile per ton, will in a manner overcome the inconvenience of the scarcity of timber in the western part of the State.

As an evidence of the rapid development of Southwestern Kansas, witness the following result of the operations of this road during the year 1871 :

| | |
|---|---|
| Gross earnings for year 1871 | $454,634 30 |
| Operating expenses for year 1871 | 300,709 65 |
| Net | $153,924 65 |
| Average length of road operated during 1871 | 106.16 miles |
| Average earnings per mile for year | $4,270 47 |
| Average cost of operating per mile for year | 2,824 62 |
| Average net earnings per mile for year | $1,445 85 |
| Interest on $15,000 road bonds per mile, at 8 per cent | 1,200 00 |
| Average earnings per mile in excess of interest on bonds | $245 85 |

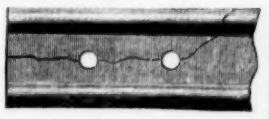
The land office was opened for the sale of granted lands March 23, 1871.

| | |
|---|---|
| Since which date there has been put on market a total of | 416,223.12 acres. |
| Of which there has been sold 69,981.51 acres, at an average price of $5.87, amounting to | $410,791.46 |
| The capital stock paid up is | $15,000 per mile. |
| The bonded debt, issued only on constructed road, is | 15,000 per mile. |
| The land bonded debt, issued only on constructed road, is | 7,500 per mile. |

The officers are: Hon. Ginery Twichell, President, Boston; Isaac T. Burr, Vice-President, Boston; T. J. Peter, General Manager, Topeka, Kansas; Chas. W. Pierce, Secretary and Treasurer, Boston; Edward Wilder, Assistant Treasurer, Topeka; M. L. Sargent, Auditor, Topeka; D. L. Larkin, Land Commissioner, Topeka; W. W. Fagan, Assistant Superintendent, Topeka; M. L. Sargent, General Freight and Ticket Agent.

The general office of the corporation is at No. 15 Devonshire street, Boston; of road, at the depot in Topeka.

**Bessemer Steel Rails.**



It is stated in *Engineering* that it was found that a piece about 15 inches long frequently broke off the end of the Bessemer cast-steel rails used in the Cologne-Minden Railway. The fracture in each case passed through the two holes for the fish-bolts, as shown in the annexed sketch. The oval holes for these bolts were formerly punched, but are now made by first drilling a round hole and afterward enlarging it by a slotting machine. It has not yet been ascertained, however, whether this will prevent the fracture just referred to.

**Car Building in New Hampshire.**

The Ranlet Car Company, at Laconia, N. H., have completed a contract for building seven hundred cars for the National or Green Line Company, and are just commencing on one to build five hundred for the Passumpsic Railroad.

# General Railroad News.

## CHICAGO RAILROAD NEWS.

**Chicago, Rock Island & Pacific.**

The following general order was issued by Hugh Riddle, General Superintendent, under date of December 15:

"H. M. Aller, Esq., has been appointed General Southwestern Agent of the Chicago, Rock Island & Pacific Railroad, with headquarters at Leavenworth, Kansas.

"Mr. Aller will also have charge of the business of Leavenworth and Bridgeport stations, and all communications relating thereto should be addressed to him."

Mr. Aller is one of the Directors and also Secretary of the Chicago & Southwestern Railway Company.

A correspondent of the Chicago *Evening Post*, who has recently passed over the Chicago & Southwestern road, now operated by the above company, says:

"For a new road it is certainly an excellent one, the track being for the most part smooth and level, and the bridge and culvert work of the most substantial character. Freight goes from Leavenworth to Chicago, 520 miles, without change, and already a very heavy business is done in the live stock and grain and general produce, and bringing back merchandise, agricultural and other machinery, and lumber. The road traverses the best agricultural and stock-raising districts in Iowa and Missouri, and thrifty villages are springing up all along."

**Chicago, Burlington & Quincy.**

This company is laying steel-rails on its main line between Chicago and Aurora as fast as it can get the rails, a part of which, at least, are manufactured in Chicago, at the Union Rolling Mills.

The new foundry in Aurora was started on the 12th inst., and is now in full blast.

The grading for the double track between Aurora and Hinsdale (from Chicago to Hinsdale it is laid) is nearly completed, and the masonry will be ready about the 1st of January.

**Chicago & Northwestern.**

In order to make the shortest connection between Chicago and the new Madison Extension of this road, which, when completed, will receive the company's entire Minnesota business, it is necessary to construct a short road to connect the Wisconsin Division with the Belvidere & Madison Branch. This connection can be made between Shopiere and Afton by a line only six or seven miles long. Janesville desires to be the eastern terminus of this connecting line, and proposes that it be built from that place northward to Evansville, in which case it will be about 15 miles long. It also wishes it extended southward about seven miles to Afton, on the same Belvidere & Madison Branch, so that it would form a loop line, passing through Janesville, and permitting the passage of cars from the part of the Wisconsin Division north of Janesville southward to Belvidere and the western part of the Freeport line. It is understood that the Northwestern will construct this line on condition that the people of Janesville pay the excess of its cost over that of a line from Shopiere to Afton.

## RAILROAD LAW.

**Accident Insurance.**

In a case recently decided by the New York Supreme Court (2 Lansing, 166), it was decided that a policy of insurance against personal injury "caused by any accident" while traveling by public or private conveyance provided for the transportation of passengers, etc., does not cover a case where the insured, after landing from a steamboat, started to walk from the landing to the railroad station, about 70 rods, and on the way slipped and fell on the sidewalk and was fatally injured. Judge Smith decided that the passenger must be traveling by some "conveyance;" that an accident in stepping from a boat or car or carriage, or in the carriage conveying the insured from landing to depot, would be covered by the insurance, but not one met with in walking.

**The Michigan Railroad Aid Bonds.**

We learn from a Michigan paper that the Supreme Court of that State in the Bay City Railroad aid case has granted a mandamus ordering the State Treasurer to return to the city the bonds of $100,000 voted and issued to aid in the construction of the Jackson, Lansing & Saginaw Railroad. If this precedent governs all similar cases, the bonds now on deposit in the State Treasury may, and probably will be, all recovered by the corporations which issued them, and destroyed, thus annulling the chief evidence of the debts so intended to have been incurred.

## ELECTIONS AND APPOINTMENTS.

—A circular from Leland Stanford, President of the Central Pacific Railroad Company, who has lately become President of the Stockton & Copperopolis and the Stockton & Visalia railroad companies also, announces the appointment of Mr. A. N. Towne as General Superintendent of those roads. Mr. Towne has long been numbered among the "men with nothing to do." He now is General Superintendent and manages the operation of the Central Pacific, which, with its branches, measures 1,091 miles; the California Pacific, 177 miles; the Southern Pacific (of California), 120 miles; and the two named above, 48 miles. This is a total of 1,436 miles of railroad, including nearly every mile in the State of California, under Mr. Towne's management; besides which he amuses himself with superintendency of 44 steamboats, which are owned by the same association of capitalists. It is doubtful whether there is any other one man who manages so admirably so extensive and so complex a business, and at the same time preserves his native equanimity and a tender regard not only for the rights but for the feelings of those with whom he has to deal. Mr. Towne received his railroad education on the Chicago, Burlington & Quincy Railroad, which has graduated so many accomplished and prominent managers. He rose on that road from the position of brakeman to that of Assistant General Superintendent, and from that position was called to his present place; though for a time he was General Superintendent of the "Chicago & Great Eastern Railroad," afterward a part of the "Columbus, Chicago & Indiana Central," and for a few years the Chicago Division of the Pittsburgh, Cincinnati & St. Louis Railway.

—At a meeting of the stockholders of the Northern Nebraska & Dakota Central Railroad Company, held at Covington, Nebraska, on the 14th, the following Board of Directors was elected: Judge A. W. Hubbard, Mayor of St. Davis; John Cleghorn, C. E. Hedges, John H. Charles, James E. Booge, Sioux City; Governor John Burbank, Dakota; John Stough, Panca, Neb.; J. Brannan, Franklin, Neb.; C. P. Heath, Simon Rienean, Covington, Neb.; C. C. Van, Dixon County; James Statt, C. F. Eckhart, Dakota City, Neb. At a subsequent meeting of the Directors, A. W. Hubbard was elected President, D. T. Gilman, Treasurer, and Simon Rienean, Secretary.

—The "New York Elevated Railway Company" is the title of the new corporation which obtained possession of this railroad at the recent sale under the mortgage. Its officers and directors are as follows: W. L. Scott, President; David Dows, Treasurer; D. N. Barney, F. H. Tows, Ashbel H. Barney, John D. Main, Harry Kennedy, W. L. Wallace, Geo. H. Marvin, John A. Cowing, Geo. C. Martin, Alfred C. Barnes, F. A. Foster.

—Mr. H. M. Aller has been appointed General Southwestern Agent of the Chicago, Rock Island & Pacific Railroad, with headquarters at Leavenworth, Kansas.

—The following is a list of the directors of the reorganized Atlantic & Great Western Railway Company as elected December 11, at which time the final consolidation was ratified: General George B. McClellan, W. B. Duncan, General George B. Wright, Samuel L. M. Barlow, Abram S. Hewitt, Lawrence Wells, Lloyd Aspinwall, H. F. Sweetser, James B. Hodgskin, Reuben Hitchcock, John Tod, W. S. Sharp and James McHenry. The board of directors then held a meeting and elected the following officers: President, General G. B. McClellan; Vice-President, General G. B. Wright; Treasurer, J. B. Hodgskin; General Manager, H. F. Sweetser; Secretary, Charles Day; Auditor, C. W. Winslow. These directors are nearly all widely known, and of the highest reputation. The stockholders have every reason to believe that the affairs of the company will be managed with the strictest integrity.

—Mr. C. W. Smith, General Manager of the Peoria & Rock Island Railway, under date of December 18, makes the following announcements: "Appointments to fill the several offices under the general management have this day been made as follows: J. R. Hilliard, General Superintendent; J. A. Grier, General Freight and Ticket Agent; Charles P. James, Treasurer; Theodore Mosher, Master Mechanic. Each will assume the duties of his respective office at once, and his orders will be respected accordingly. Headquarters at Peoria, Ill."

—Mr. Isaac L Downs, for some time passenger agent of the Chicago & Alton Railroad in St. Louis, has resigned, and Mr. S. H. Knight, formerly Assistant Superintendent of the road and afterward General Superintendent of the North Missouri Railroad, has been appointed in his place.

—The following gentlemen have been elected officers of the Gainsville & Dahlonega, Ga., Narrow-gauge Railroad: President, Captain Bondurant, of Gainsville; Vice-President, Dr. H. M. Van Dyke, of Dahlonega; Directors, Hon. W. P. Price, Colonel Weir Boyd, Colonel Ben. Martin, Captain J. Woodward, Dahlonega; Judge J. W. Davis, Captain Minor, Colonel Langston, Colonel A. D. Chandler and Colonel O. B. Thompson, of Gainsville.

## TRAFFIC AND EARNINGS.

—Recently the Baltimore & Ohio Company has been carrying grain from St. Louis to Baltimore for 43 cents per hundred, and to New England (steamer from Baltimore) for 54 cents, while the rate from Chicago was 60 cents from Baltimore and 70 to New England points. White Line cars at the same time were carrying grain from St. Louis to Boston for 59 cents, the rate being 70 cents from Chicago. The difference is usually the other way.

—The Buffalo *Commercial Advertiser* makes the following summary of the statistics of that port for the past season:

"By this statement it appears that the number of vessels arriving at and departing from this port, during the past season, was greater than during any year since 1868; also, that the tonnage of the port has aggregated more than in any year since 1867. The total number of vessels which have reported and cleared this season was 10,894, against 10,625 last year and 10,201 in 1869. The aggregate capacity of these vessels was 4,892,641 tons in 1871, 4,157,793 tons last year, and 4,007,496 tons in 1869. The excess of tonnage in 1871 was 734,848 tons over that of 1870, and 885,145 tons over that of the year previous. From a careful examination of the marine statistics of the port for previous seasons, it appears that for several years past our trade has been undergoing a great change. While the coastwise trade—that is, the trade between Buffalo and other United States ports—has been steadily growing, the trade in American bottoms between this port and Canada has been declining in about the same ratio. We have noted this falling off in the Canadian trade ever since the abrogation of the Reciprocity Treaty, but were not prepared to find so great a decline. In 1865 the tonnage of the American vessels trading between Buffalo and Canada was 4,293,969 tons, in 1866 it was 4,247,525 tons, while this year the aggregate tonnage of American vessels trading with Canada was only 887,841 tons. A comparison of the trade of this year with that of 1870 shows an increase in coastwise tonnage of 808,585 tons, which is certainly a very handsome gain; while a decrease of 73,657 tons has taken place in vessels engaged in the foreign trade."

—The shippers of Wilmington, N. C., have established a new line of steamers to run to New York, to be called the "New York & Wilmington Line." The first steamer, the "Metropolis," sailed from New York to Wilmington December 23.

—At a recent meeting of the Scioto Valley Railroad Company, which is now canvassing for subscriptions, the following directors were chosen: James Emmitt, Pike County, Ohio; Edward E. Smith and W. E Bolin, Pickaway County; L. G. Delano and W. C. Williams, Ross County; George Davis and Thomas Dugan, Scioto County.

—A Louisiana engineer was acquitted of neglect in running over a man, because "the grass on the track grew so high as to obscure the person."

—The St. Joseph *Gazette* understands that there are now three hundred and fifty suits pending in the Clinton County Circuit Court against the Hannibal & St. Joseph Railroad Company, all brought by one individual under a statute which inflicts a penalty of $20, half of which goes to the informer, for failing to ring the engine bell at railroad crossings. The suits were originally brought before a justice of the peace and judgment rendered by default against the company, which they appealed to the circuit court.

—The Springfield *Republican* of the 19th says:

"By the completion of the third rail on the Albany & Susquehanna Railroad and the construction of a branch of 21 miles, coal can be brought in Boston & Albany cars direct from the mines at Carbondale and Wilkesbarre, Pa., to this city. The first lot of cars left Albany for the mines on Thursday, returned on Saturday and will arrive here to-day or to-morrow. This is an arrangement which dealers and consignees in this vicinity will appreciate."

—The traffic receipts of the Grand Trunk of Canada for the week ending December 2, amounted to £36,300, against £36,200 in the corresponding week of last year, showing an increase of £100.

—The traffic receipts of the Great Western of Canada for the week ending December 1, amounted to £20,126, against £17,206 in the corresponding week of last year, showing an increase of £2,920.

—The receipts of the Atlantic & Great Western for the month of October were $397,394, as compared with $376,366 for the previous month of September.

—For the second week in December the Lake Shore & Michigan Southern reports receipts amounting to $313,791 in 1871, against $295,600 in 1870; the Toledo, Wabash & Western, $122,428, against $95,390; the St. Louis & Iron Mountain, $48,971 in 1871, and $52,731 in 1870; the Marietta & Cincinnati, $37,327 in 1871, and $31,708 in 1870.

—The Pacific of Missouri reports $77,186 for the third week of December, 1871, and $77,921 for the same week of 1870.

—The freight rates by steamer from New York to Liverpool and London are now about 12½ to 13 cents per bushel for corn and wheat, and 85 cents per barrel for pork. It costs nearly three times as much to transport a bushel of grain from Chicago to New York, at this season, as from New York to Liverpool.

—The Boston, Hartford & Erie Railroad earned $135,334 above its operating expenses during the last financial year.

## OLD AND NEW ROADS.

**Grand Rapids and Indiana.**

A correspondent of the Detroit *Tribune* gives the following:

"The land grant of the road terminates at Little Traverse Bay, which is 110 miles north of Clam Lake, or 320 miles north of Fort Wayne. To secure this the road must be completed to that point by July 1, 1874. This will undoubtedly be accomplished when the fact is taken into consideration that the company built 160 miles in 1870, 36 in 1871, and intend to finish 75 next year. Two miles north of where the road crosses the Manistee (110 miles north of Grand Rapids), it is proposed to run a branch to Traverse City. Instead of terminating the road at Traverse City, the company intends to extend it to the Straits of Mackinaw, about 30 miles beyond.

"The entire land grant of the road was 1,116,000 acres, though the company will not probably get more than 850,000. From one-quarter to two-fifths of this is good pine land. A considerable amount has already been sold at an average of about $15 per acre, the best being picked out. It is probable that the whole will average from $8 to $10 per acre."

**Quebec & Gosfo d.**

The Quebec Legislature has sanctioned the increase of this company's capital from $950,000 to $2,500,000, in order to have the road extended to Lake St. John, and also extended the time for the completion of the road from 1876 to 1878.

**Railroad Charters in Ohio.**

The recent report of Hon. Isaac R. Sherman, Secretary of State of Ohio, gives the following list of railroad charters issued in that State during the year:

"The Southern Ohio Railroad Company, commencing at the mouth of Symmes Creek, and passing through Lawrence, Gallia, Jackson, Pike, Highland, Clinton, Warren, Greene and Montgomery counties to Dayton. Capital, $3,000,000.

"The Dayton & Mineral Region Railroad Company, commencing at Dayton and passing through Montgomery, Greene, Clarke, Madison, Fayette, Franklin, Pickaway, Fairfield, Perry (by way of Somerset), Morgan, Muskingum, Noble, Guernsey, Monroe and Belmont counties to Bellaire. Capital, $2,500,000.

"The Wheeling & Toledo Railroad Company, commencing at Bridgeport, and passing through Belmont,

Harrison, Tuscarawas, Stark, Holmes, Wayne, Ashland, Richland, Crawford, Huron, Seneca, Sandusky, Ottawa, Wood and Lucas counties to Toledo. Capital, $1,000 000.

"The Cincinnati & Michigan Railroad Company, commencing at Cincinnati and passing through Hamilton, Warren, Butler, Montgomery, Miami, Drake, Mercer, Van Wert, Paulding, Defiance and Williams counties to the north line of the State. Capital, $1,500,000.

"The Dayton, Stillwater & Saginaw Valley Railroad Company, with a capital of $1,000,000; and the Cincinnati & Great Northern Railroad Company, both having the same termini and passing through the same counties as the Cincinnati & Michigan, were also incorporated.

"The Hillsboro & Cincinnati Short Line, commencing at Cincinnati and passing through Hamilton, Clermont, Brown and Highland counties to Hillsboro. Capital, $1,500 000.

"Railroads were consolidated as follows: The Baltimore, Pittsburgh & Continental, with the Celina extension, forming the Baltimore, Pittsburgh & Chicago; the Mansfield, Coldwater & Lake Michigan with the Ohio & Michigan, forming the Mansfield, Coldwater & Lake Michigan; the Northwestern Ohio with the Chicago & Canada Southern; the North American with New York Western; the Chicago & Canada Southern, and the Southwestern Michigan, forming the Chicago & Canada Southern."

**May's Landing & Tuckahoe.**

Application will be made at the next session of the New Jersey Legislature for an act authorizing the construction of a railroad from May's Landing to Tuckahoe, with the privilege of extending the same to the Cape May & Millville Railroad, at or near Mount Pleasant Station, in Cape May County.

**New Jersey West Line.**

This road is now completed from Summit, on the Morris & Essex Railroad, 22 miles west of New York, westward to Bernardsville.

**Davenport & St. Paul.**

Surveys have been commenced for an extension of this road from Fayette, Fayette County, Iowa, northward to St. Paul.

**Union Depot in Peoria.**

Peoria is talking of a union depot for all the railroads which enter that place, now very numerous, including the Chicago, Rock Island & Pacific, Chicago, Burlington & Quincy, Toledo, Peoria & Warsaw, Peoria, Pekin & Jacksonville, Peoria, Atlanta & Decatur, and Peoria & Rock Island; while trains of the Indianapolis, Bloomington & Western enter the city.

**Milwaukee & Northern.**

The track has been extended this season from Cedarburg to Fredonia.

**New York Elevated Railway.**

The present proprietors of this property threaten to complete it to the Harlem River, and stock it with new engines and cars, as soon as possible. One might think that it would be well to utilize the three or four miles completed before spending any more money in extending it.

**Indiana North & South Railroad.**

Of this, a well-informed correspondent writes to us as follows from Indianapolis, under date of December 19:

"The grading on the Indiana North & South Railroad from Attica to Chambersburg is completed, and tracklaying commenced on the 14th inst. at Chambersburg, and will be completed by the 20th day of January next. Good American iron, with fish plate joints, manufactured at Harrisburg, Pa., and weighing 56 pounds to the yard, is being used. The road runs through the finest coal-fields of Indiana. Fountain County has as fine cannel coal as can be found anywhere, and the block coal is superior to any found west of Pittsburgh, and is in inexhaustible quantities.

"This road, intersecting the Indianapolis, Bloomington & Western Railroad at Chambersburg, and the Toledo, Wabash & Western at Attica, will furnish an outlet for the products of the mines that are being opened by Eastern capitalists.

"About seventeen miles of the grading, between Brazil and Rockville, running through the counties of Parke and Clay, both underlaid with the best of coal, is completed, and will speedily be completed from Brazil to Newburg, on the Ohio River, running through a country rich in coal and iron. The iron ore found on the line of this road is said to be of the best quality.

"Mathers, Chamberlain & Co., the gentlemen having the contract for construction and equipping, are well known as successful and experienced railroad men, and Dewey & Mitchell, who have the contract for grading, being men of ability, long experience and ample means, we may confidently look forward to the early completion of the road, and the country through which it lays furnishes sufficient guaranty to predict that it will be a paying one."

**California Railroads.**

The San Francisco *Call* says: "California has at this time nine hundred and two and a half miles of railroad in active operation as follows: Main Central Pacific Road (to State line), 293; California and Oregon Branch of same (Roseville Junction to Red Bluff), 115 miles; San Joaquin Valley Branch of same (Lathrop to Bear Creek), 58 miles; Southern Pacific (to Hollister), 100 miles; Watsonville Branch of same, 20 miles; California Pacific (Vallejo to Marysville), 95; Napa Valley Branch of same (to Calistoga), 33; North Pacific (Donahue to Healdsburg), 42; Sacramento Valley road, 48; California Northern (Marysville to Oroville), 26; San Pedro & Los Angeles, 21; Stockton & Copperopolis road to Milton, 48; San Rafael & San Quentin, 3½. It is safe to say that in another year two or three hundred miles more of roads will be added to the list."

**Toledo & St. Louis.**

The St. Louis *Republican* says that the contract for the construction and equipment of this railroad, from St. Louis eastward to the Indiana line, was let December 14 to Col. Thomas S. Sprague, of Detroit, and Willis, Phelps & Co., of Springfield, Mass. Work is to commence next spring. It is said that nearly half a million of dollars, and a good portion of the right of way, have been secured in Illinois.

**Maine Railroads.**

A Maine correspondent of the Boston *Advertiser* says: "The wise-heads say that the Boston & Maine will make a determined effort to extend their road from Portland to Bath, from thence to Wiscasset, and tapping the Kennebec region by its connection with the newly-surveyed Kennebec & Wiscasset Railroad. But this is denied by the friends of the Boston & Maine, who assert that, having gained their point last winter in obtaining their extension from Boston to Portland, they will content themselves with remaining quiet for the present, awaiting further developments. I have just learned that a new shore line of railroad is contemplated by the Portland, Saco & Portsmouth, extending from Biddeford to Kittery, shortening the distance between the two places *thirteen* miles, and giving railroad facilities to several important towns that are now without them. A charter will be asked for a railroad to commence at the tide-waters of Castine, running through Castine, Penobscot, Bluehill, Ellsworth, East Machias, Calais and other towns, to the tide-waters of Calais; one for a railroad from some point on Union River and following said river to its mouth; one for a railroad from Bangor through Ellsworth, Cherryfield and Machias, to the east line of the State, with branches to Lubec and Castine, and with the right to form a connection with the Penobscot & Union Railroad, or with any other railroad; one for a railroad from some point at or near the northern terminus of the Georges Valley Railroad, to a point upon either the Maine Central or European & North American railroads, in the town of Hampden; one for a railroad from Bangor to the Piscataquis River, passing through Kenduskeag, East Corinth and Charleston. The Bangor & Piscataquis Railroad will ask for amendments to their charter, enabling them to locate and construct branch roads from certain points on their present line to Milo, Brownville and Sebec. This is asked for more particularly on account of the rich slate quarries in Brownville and other parts of Piscataquis county."

**Saginaw & St. Louis.**

The Detroit *Tribune* of the 23d inst. says: "A section of 20 miles, commencing at the south bank of the Tittabawassee River, is under contract, and upward of six miles of it is graded and prepared for the ties, and about nine miles cleared and ready for the pick and shovel. About 100 men are now at work on the road, and over $20,000 has been paid in by the stockholders and expended. Mr. Charles McLain is the contractor for all the timber required on the line for culverts and cattle-guards, and Mr. A. Willey supplies all the ties at 20 cents. All talk of a narrow gauge has been abandoned."

**St. Clair River & Saginaw.**

Efforts are making for a line, or rather two lines, between the St. Clair River and Saginaw. One party would have it made from Port Huron, to connect with the Grand Trunk and Great Western, while the other would make the southern terminus at St. Clair and the connection with the Canada Southern. It would be easy enough to make the road from St. Clair through Port Huron and thus connect with all the railroads and the best towns.

**Grand Rapids & Lansing.**

Grand Rapids is talking of a new railroad to Lansing, there to connect with the Detroit, Lansing & Lake Michigan Railroad, forming a new route to Detroit 13¾ miles shorter than the shortest now existing.

**Grand Rapids & Holland.**

This railroad is now completed, and it lessens the distance between Grand Rapids and Chicago by seven miles. It is 25½ miles long.

**Michigan Midland.**

The Detroit *Tribune* says that the engineers have completed the location of this railroad from St. Clair to Fenton, on the Detroit & Milwaukee Railroad, passing a short distance north of Holly, and that its maximum grade on this section will be 25 feet. There are reports that an attempt will be made to continue it across the State to Lake Michigan at Holland or Black Lake.

**Petaluma & Stockton.**

The engineers have completed a survey for this proposed new California railroad.

**Walla Walla & Columbia.**

This Oregon railroad line has been located, and it is intended to do a large part of the grading this winter and complete it by the end of 1872.

**Oregon & California.**

The line has been located and the stakes set for the graders as far south as the North Umpqua River, and work is to continue through the winter.

**St. Louis & Keokuk.**

Work was commenced lately on the grading of this road at Clarksville, a town on the Mississippi a short distance south of Louisiana.

**Northern Pacific.**

Oregon papers announce that Capt. Maxwell's party have completed the survey of the Ononqualamie Pass, Oregon, and its eastern approaches, and have commenced running a line from Lake Chitman eastward, to the pass of the Cour de Leone, which completes the survey across the Continent. Seattle papers represent the excitement in terminal lands was very great. Parcels of land worth $1,000 two weeks ago have advanced to $10,000. One hundred acres which sold two weeks ago for $2,000 changed hands for $5,000 and now is held at $10,000.

**Missouri, Kansas & Texas.**

The commissioners appointed to examine the Missouri, Kansas & Texas Railway and report on the condition of the part in the Indian Territory as far as Gibson Station, 87 miles, have reported favorably.

"It is laid with fish-plate iron weighing 56 pounds to the yard, and the ties are of hard oak wood laid 2,700 to the mile. The culverts and stone-work are good, solid and durable. The maximum grade through, or rather so far is to, the Indian Territory is about 52 feet to the mile, with easy curves and generally straight lines. The bridge across the Arkansas is now about complete, ties are now delivered and the iron will soon be laid to the Canadian. Work is being pushed ahead toward the Southern terminus at Galveston."

**Atlantic Coast Line.**

In a circular to general ticket agents, Mr. A. Pope, general ticket agent of the Wilmington & Wilton and the Wilmington, Columbia & Augusta railroads announces that this route from Wilmington to the South has been improved by the extension of the Wilmington, Columbia & Augusta road from Sumpter to Columbia, S.C.

"By an arrangement with the Charlotte, Columbia & Augusta Railway all facilities of transportation necessary to unrestricted communication with Augusta, Ga., likewise exist, and we are thus enabled to present to the public a new line to Augusta and all Southern points, decreased in length seventeen miles, improved in roadway to the extent of forty-two miles of entirely new road of superior construction, diverging from the old route in a manner that enables the avoidance of long trestles, gives a greatly improved location, and materially shortens the time of transportation."

**St. Louis & Cedar Rapids.**

Several contracts for the construction of this railroad from Ottumwa northeast to Cedar Rapids have been made but have not been fulfilled. The President gives the following account of the present condition of the property:

"We are now negotiating with parties in England to take our bonds and furnish us what we need for its completion. Twenty-eight miles of the road (from Ottumwa to Sigourney) are completely graded and partly bridged. From Sigourney to this place (Cedar Rapids) three lines have been carefully surveyed, and much of the right of way obtained. We now lack but the small amount of $75,000 to grade and bridge the entire 87 miles to this city."

**Cincinnati & Dayton Short Line.**

The Dayton (O.) *Journal* of the 20th says:

"The rapidity with which the work on the Short Line has been pressed is among the remarkable feats of railroad building. It will be remembered that during the contest before the Legislature to secure for the Short Line the use of the track of the Cincinnati, Hamilton & Dayton on Sixth street, the strong point for the opposition to that grant was that there was no intention on the part of the Short Liners to make the road. But now, within nine months after the adjournment of the Legislature, which cut off all hope of securing the desired legislation, nearly the whole line from Cincinnati to Dayton is graded, and within a year after the adjournment the track will be laid and trains running. Forty-three miles of the line are now ready for the ties, and the grading of the remaining three miles will be completed in January, so as to connect with the heavy work which the Baltimore & Ohio has been doing in Mill Creek Valley, and over which the Short Line will enter Cincinnati. It is the intention of the Short Line managers to let the tracklaying in short sections, so as to work a large force to good advantage, and thus complete the whole job with great expedition. By May, at the furthest, the steel rails will be laid, the track ballasted and a road to Cincinnati some seven miles shorter than the Cincinnati, Hamilton & Dayton will be ready for business."

**Columbus, Springfield & Cincinnati.**

This railroad extends from Columbus, Ohio, westward 20 miles, close to the line of the Columbus & Xenia road, to London, where is the eastern terminus of the Springfield & Columbus Railroad. It was completed on the 19th instant. One-fifth of this railroad is owned by each of the following parties: The New York Central & Hudson River Railroad Company; the Cleveland, Columbus, Cincinnati & Indianapolis; the Cleveland, Sandusky & Cincinnati; the Baltimore & Ohio, and the heirs of Jacob W. Pierce. Rush R. Sloane, President and Superintendent of the Cincinnati, Sandusky & Cleveland Company, is President of the new company, and the former is to operate the new road. It will connect with the new line to Cincinnati at Springfield.

**North & South of Georgia.**

Messrs. Clink & Cherry, of Columbus, Georgia, have taken the contract to grade fifteen miles of the North & South Railroad, and have commenced the work on the Rome end.

**Lafayette, Bloomington & Mississippi.**

It is expected that trains will commence running over this road between Lafayette and Bloomington early in January.

**Independence & Kansas City.**

A considerable amount has been subscribed toward the construction of a narrow-gauge railroad from Kansas City east to Independence, about ten miles, and surveys are soon to be made. The two towns are now connected by the Missouri Pacific.

**Long Island Railroads.**

The New York *Tribune* of December 22 has the following:

"The Smithtown & Port Jefferson extension of the Long Island Railroad is advancing rapidly. The contractors are now engaged with a large force of men in grading at Smithtown Branch, Stony Brook, St. James and other points. The road will be completed next summer. Grading for the double track of the Long Island Railroad from Hunter's Point to Winfield was begun last week. The iron and ties have been received for this new track, and the work will be pushed forward rapidly.

"Work has also been begun on the meadow section of the new road from Newtown to Flushing. The Flushing & North Side Railroad Company has made surveys and partial arrangements to build a branch to Rockaway and

the beach. The company purposes to run for a short distance on the Hempstead Plains road, and to cross the hills near the Titus farm, at East Jamaica. Work on this road will be begun early in the spring. On the extension of the Flushing & North Side road to Whitestone considerable progress has been made. After Christmas a large force of men with a steam shovel will be employed.

"The Committee of Citizens of the village of Huntington, appointed to consider the prospects for railroad communication with New York, reports favorable negotiations in regard to the extension of the North Shore Railroad to that village. The South Side Railroad Company, when spring opens, will probably extend its road to Moriches. The rumor that the company had purchased the Sag Harbor Branch of the Long Island Railroad is unfounded. The Rockaway Branch of the Long Island Railroad has been completed to Ocean Point, but owing to a difficulty in obtaining a further right of way work has been suspended. Work has also been stopped on the Hempstead and Bay Ridge road, but will soon be resumed, as a portion of the road is to be in running order by April 1. A portion of this road was graded during the past summer.

"A new company has recently been formed to build a railroad from Brooklyn to Orient Point, in connection with the Bay Ridge road at Woodhaven, and passing east of Jamaica, through the principal villages on the north side of the island. On the Hempstead Plains road about six miles of track have been laid, and at the west end work is advancing.

"The farmers on the line of the Jericho turnpike, from Jericho to Queens, who use the road as an outlet for their produce to the New York markets, in connection with the stockholders of the road, are about to lay an iron track on the bed of the road. If the Hempstead & Jamaica Turnpike Company place a track on its road from Queens to Jamaica, as proposed, the farmers will have the benefit of an iron track from Jericho to the Brooklyn ferries, a distance of twenty-three miles. The track is greatly needed, especially in the spring, when the road is almost impassable for heavy teams."

**Huron Shore Railroad.**

This company proposes to construct a railroad from Alpena, Mich., through Au Sable to Standish, there to connect with the Jackson, Lansing & Saginaw Railroad, which is to iron and operate the road when the road bed is completed.

**French Locomotives in America.**

The collector of customs in New Orleans advertises that he will sell at auction January 10 ten locomotives of 5ft. 6in. gauge, built by Andrew Roechlin, of Mulhouse, France, they having remained in warehouse unclaimed more than o .e year. These must be a portion of the purchase made in France some time ago for the Southern Pacific Railroad, known as "Fremont's road."

**Dividends.**

The Reading Company pays a semi-annual dividend of 5 per cent. on common and preferred stock, January 15, at the office in Philadelphia. The Delaware & Hudson Canal Company pay 3½ per cent., less tax, on stock of the Rensselaer & Saratoga and the Albany & Susquehanna companies after January 1. The Norwich & Worcester Company pays a semi-annual dividend of 5 per cent. in Boston, January 1. The Hartford & New Haven pays a quarterly dividend of 3 per cent. on each share of full stock, and 1½ per cent. on each share of scrip, at the Union National Bank, in New York and in Hartford. The Chicago & Northwestern divides 3½ per cent., less tax, on preferred stock; the New York & Harlem a semi-annual dividend of 4 per cent.; the New Jersey Railroad & Transportation Company 7 per cent., and an extra dividend of 1 per cent., payable January 20, at No. 111 Liberty street, New York; the Central of New Jersey a quarterly dividend of 2½ per cent.

The Philadelphia, Wilmington & Baltimore Company divides 4 per cent. for the half year, payable January 2, free of tax.

**Lake Erie & Louisville.**

It is reported that this company, whose road has long been in operation from Fremont, O., on the Lake Shore & Michigan Southern 30 miles southeast of Toledo, southwest 37 miles to Findlay, has been reorganized, and will extend its road to Lima, O., about 30 miles, early next spring.

**St. Louis, Alton & Terre Haute.**

The preferred stockholders will hold a meeting at No. 12 Wall street, New York, January 10, to consider the question of an increase of the preferred stock of the company, in accordance with the provisions of the deed of trust. All holders of the above-mentioned stock are requested to be present in person or by proxy. The transfer books of the preferred stock will be closed on the 2d of January until the 11th of January, 1872. The holders of the preferred second mortgage bonds and the second mortgage income bonds will also meet on the 17th of January, to authorize this increase.

**Shepang Valley.**

Of this railroad a correspondent writes:

"The last rail of this road was laid Thursday, December 27, about 11 a. m., within the same hour that witnessed the completion of the Connecticut Western Railroad, the junction of track from the two ends being effected without cutting either rail (a coincidence). This work was built by Wm. Hinds, of Washington, Conn., in 13½ months, ground being broken October 25, 1870. It is 32½ miles in length, from Hawleyville on the Housatonic Railroad to Litchfield. Trains began December 20 to make regular trips over the road for general business, but the work of ballasting up still continues. Three Rogers locomotives and cars of New Haven Car Company make comprise the present equipment. F. W. Northrop, of New Haven, is the Superintendent, and its Chief Engineer Samuel Stevenson, of Scranton, Pa., who has also settled the land damages. The entire right of way has cost within fifteen thousand dollars, and the grading, including 700 feet of bridging, amounts to about $11,000 per mile. An extension to Bethel, on the Danbury & Norwalk Railroad, is under construction, which makes an air line from Litchfield to New York when completed.

**Lima, Lafayette & Mississippi.**

Engineers have commenced preliminary surveys for this proposed railroad, which is to extend from Lima, Ohio, on the Pittsburgh, Fort Wayne & Chicago Railway, at its junction with the Dayton & Michigan, a little south of west to Lafayette, Ind., through a district perhaps as well able to support a new railroad as any in Northern Indiana. The chief labor of the projectors of the road at present is the securing of local subscriptions.

**Dubuque, Platteville & Monroe.**

The Platteville (Wis.) *Witness* says that the survey for this proposed railroad has been completed from Dubuque to Platteville. The route is reported by the engineer to be much better than was expected, the average grade not exceeding 11 feet to the mile from Platteville to the bridge at Dubuque. The maximum grade is 50 feet to the mile, and only for a very short distance. The survey goes down Rountree's Branch to the Platte, thence to the Mississippi. After finishing the work to Platteville the engineers proceeded to Gratiot and connected the survey made in 1869 by the Milwaukee & St. Paul Company with that to Platteville, so that the survey is practically finished to Monroe.

**Wisconsin Central.**

Concerning the location of the northern part of this road, the Bayfield *Press* says that it has been completed from Penoka Gap to Ashland Bay. The grade from the bay to the Range is a trifle over 40 feet to the mile, and the distance—air line—is 24 miles, and the location is only 28¾ miles from the bay to the Gap, which is a remarkably small difference in the distance when the roughness of the country is considered. The Gap, where the road is to pass through on its way to Stevens Point, is about 700 feet above Lake Superior. The heaviest grade will be in the vicinity of Silver Creek, where the ground is very rough; and there will be several streams with precipitous banks to cross. The Penoka Range, which this part of the road will connect with Lake Superior, is expected to furnish heavy freights of iron ore.

**Midland Pacific.**

Lincoln, Neb., the present Western terminus of this railroad, has voted to subscribe $100,000 to this company to aid in the extension of its road northwestward to a junction with the Union Pacific at Columbus or Grand Island. Columbus is 92 miles and Grand Island 154 miles west of Omaha, while Kearney, the western terminus of the Burlington & Missouri River Railroad, is 191 miles from that place.

This subscription is made on condition that the principal shops for constructing and repairing the rolling stock of this road shall be in Lincoln.

**Superior & Northern Pacific Junction.**

The Superior City *Times* of late date says: "We expect in our next issue to have the pleasure to announce that contracts have been let for the entire line from the Bay of Superior to the Northern Pacific Junction."

**Boston & Maine.**

The directors have voted to distribute two new shares, at par, for every five of the old stock, to be paid in five installments.

**Logansport, Crawfordsville & Southwestern.**

This railroad is now completed to its southern terminus at Rockville, Ind., where it connects with the Evansville & Crawfordsville Railroad.

**Portland & Rochester.**

A correspondent writing from Portland, Me., under date of December 22, says: "This road is now open from Portland to Rochester, N. H. (52½ miles from Portland), where it is to meet with the Nashua & Rochester Railroad (now being located), which road is under lease to the Worcester & Nashua Railroad for 20 years, at 6 per cent. upon cost, thus forming a trunk line from Portland to New York *via* Worcester, Mass., saving 44 miles of distance to Eastern people over route *via* Boston.

"Mr. W. H. Turner (Freight Master of Norwich & Worcester Railroad), a thorough and efficient railroad man, was appointed Superintendent, and entered upon his duties December 1.

"At a special meeting of stockholders of the Portland & Rochester Railroad, December 13, it was voted to subscribe $100,000 to stock of Nashua & Rochester Railroad."

**New York Viaduct Railway.**

The new directors of this company have issued an address to the public on the rapid transit question. They believe the idea of an elevated road the proper one, open cuts and tunnels being also used where the grades of the island render them necessary; the company should pay for and own their own land; the railroads and other corporations which will be benefited by the road should subscribe a large part of the stock; the first cost should be as small as possible, and, if possible, city aid should not be asked.

**International of Texas.**

This company advertises its first-mortgage, sinking-fund, 7 per cent. gold bonds, having forty years to run, at the rate of $16,000 per mile on finished road, at 90.

**Walkill Valley.**

This railroad, which, in connection with the Erie, is to make the southern part of a line between New York and Oswego, of which the Rondout & Oswego will be the northern part, is in operation from its junction with the Erie at Montgomery, N. Y., northward to Rosedale, 18½ miles, and is to be opened early in January to Kingston, 13½ miles.

**Cape Girardeau & State Line.**

A correspondent of the St. Louis *Republican* writing from Cape Girardeau, Mo., under date of December 18, says:

"About eighteen months ago the Cape Girardeau & State Line Railroad Company entered into a contract with Governor Fletcher, and several so-called Eastern capitalists, to secure the early equipment of the road. At the time this contract was made seventeen miles of the roadbed were graded and tied, and our company agreed to grade the road for at least twenty miles more. The cars were promised us by the 1st of December, 1871, the time fixed for the complete equipment of the first twenty-five miles of the road. The 1st of December came and passed, and no iron, rolling stock, &c., and now the contract has been canceled by the company, and matters stand exactly as they stood eighteen months ago—with this difference, that forty miles of roadway have been constructed and supplied with ties. The promises made us by these so-called 'capitalists' were very profuse, but unfortunately they were only promises. * * * * * That the road will be a paying one is not doubted by any one familiar with the resources of the country through which it will pass. It is now graded within twenty miles of Poplar Bluff, where the Cairo & Fulton of Arkansas will connect with the Arkansas Branch of the Iron Mountain Railroad. The road will pass through a magnificent timbered section and the finest iron region of the State, according to the report of Professor Shepard."

**Missouri, Iowa & Nebraska.**

From a long article in the Keokuk *Gate City* we learn that trains are running on this railroad from Alexandria, Mo., (a few miles below Keokuk, Iowa,) westward 43 miles to Memphis, Mo., while the track is down 10 miles further, and the grading is completed still further 12 miles to Lancaster, the county seat of Schuyler County, Mo., which is within two miles of the North Missouri Railroad. All this work has been done this season by the "Iowa Railroad Contracting Company," which is reported to consist of Benjamin E. Smith, Charles J. Pusey, Andrew Carnegie, D. W. Kilbourne, Wm. Leighton, J. Edgar Thomson, Thomas A. Scott, Henry Hill and C. A. Secor, nearly all of whom are directors of the Pennsylvania Railroad Company and its leased and allied lines.

The line is very nearly straight, and is said to be remarkably well constructed. It is designed to extend it westward to Nebraska City, the western portion of the line being in Iowa, its direction being a little north of west, but it has not been definitely located west of Lancaster, a branch to Brownsville, Neb., being talked of, and one route by way of Centreville, Iowa, proposed, and one by Unionville, Mo.

**Houston & Texas Central.**

This company's western branch is now completed to Austin, Texas, and is now 110 miles long. It extends from Hempstead, its junction with the Houston & Texas Central, 50 miles northwest of Houston, a little north of west to Austin, the capital of the State.

**Troy & Greenfield.**

The contract for constructing this railroad, from North Adams, Mass., to the entrance to the Hoosac Tunnel, has been let to McClellan & Son.

**Vermont & Massachusetts.**

This company will petition the next Massachusetts Legislature for leave to straighten their road between Fitchburg and Gardner; also between Erving and Turner's Falls, and for authority to increase their capital stock to the extent of $1,500,000, or to issue bonds convertible into stock.

**Indianapolis, Bloomington & Western.**

The Indianapolis *Journal* is informed that this company is about to lay a second track on its road between Indianapolis and Urbana, which, as the line is comparatively a new one, indicates a remarkable development of business.

**Nashua & Plaistow.**

Plaistow (N.H.) brickmakers have engaged an engineer to make a railroad survey between Nashua and Plaistow to connect with the Nashua & Worcester road. The line will run through Hudson, Pelham, Windham and Salem, a distance of sixteen or eighteen miles.

**Quincy, Alton & St. Louis.**

This railroad is now completed from Quincy, Ill., southward down the Mississippi to a junction with the Louisiana Branch of the Chicago & Alton Railroad opposite Louisiana, a distance of 42 miles. When the new track is ballasted it is proposed to run trains through between Quincy and St. Louis by this and the Chicago & Alton road. Mr. N. D. Munson, Assistant Superintendent of the Chicago, Burlington & Quincy Railroad, is reported as acting as superintendent of the new road at present, while the Hannibal & St. Joseph furnishes its rolling stock.

**Canada Railroads.**

The Canadian *Monetary Times*, of the 24th inst., says: "Several of the companies report progress this week with the various works on hand. On the 15th, Mr. F. W. Cumberland, N. Barnhart and other gentlemen took a short trip over the North Grey Railway, a distance of several miles from Collingwood. The track is being laid rapidly, and it is hoped the road will be opened as far as Thornbury (14 miles from Collingwood) this winter. The remaining distance to Meaford, the terminus, is 8 or 9 miles. The two gentlemen above named, with others, also rode over the Toronto & Muskoka to Orillia, and this line will be fully opened for traffic to that village as soon as navigation closes. It is also announced that the Toronto, Grey & Bruce is open to Mount Forest. The first locomotive of the Whitby & Port Perry Railway reached that village a week ago, so that the completion of this line is assured. At a recent interview with the Attorney-General of Ontario it was arranged that the Kingston & Pembroke is to receive aid from the railway fund at the rate of $2,000 a mile for 40 miles of the road, and $3,000 a mile for the remainder, making in all about $400,000; an installment is to be paid over on the completion of each 30 miles. The Great Western Railway Company are, says the Brantford *Courier*, having a survey made of the proposed Brantford & Norfolk Railway, with the view of placing the matter clearly before the English Board of Directors."

**Riviere du Loup & Fredericton.**

The route of this proposed line, says the St. John *Telegraph*, is on the eastern side of the River St. John, commencing at St. Mary's, opposite Fredericton, passing through the valley of the Keswick, at a short distance from Woodstock, and thence to Grand Falls, with its termination at Little Falls, about 160 miles from Fredericton, and 228 from St. John, N. B. The Province of Quebec will have some seventy miles to construct from the boundary line to Riviere du Loup, and then there will be a continuous line to St. John, the commercial capital of New Brunswick, from the upper Provinces. The gauge is to be 3 ft. 6 in. The company are allowed by the Amendment Act until May, 1873, to make their surveys of the line, and until May, 1874 to commence construction. The time in which the whole railway is to be completed, under the Act, is limited to May, 1879. By the terms of the Act of Assembly, passed in April, 1870, to aid the construction of this line, the Government is to give a bonus of 10,000 acres per mile to the company, the first 25,000 acres of which are to be granted when $100,000 shall have been expended in actual work on the railway. The city councils of York and Carleton have already granted aid to the amount of $100,000 each, the former taking stock to that amount and the latter giving their grant as a bonus, and the Sessions of Victoria has guaranteed $50,000. The city of Fredericton, and the New Brunswick & Nova Scotia Land Company take $25,000 each in stock.

**Toronto & Nipissing.**

The *Canadian Monetary Times* says that at a special general meeting of shareholders, held on the 8th, in the office of the company, Toronto, a certificate of the engineer was read, showing that $965,580 was expended on construction, etc., whereupon authority was given to the directors, by resolution, to issue $103,000 additional bonds of the company. The Vice-President, Mr. Wm. Gooderham, Jr., stated that a meeting would be held with the directors of the Midland on the 15th, for the purpose of endeavoring to make friendly running arrangements with them. It was expected that the Nipissing would be open by that time to Woodville, the junction of the two lines, which is 72 miles from Toronto. Track-laying and ballasting between Woodville and Coboconk is progressing, and it is expected that the line will be opened to the latter point by the 1st of July next.

## THE SCRAP HEAP.

**Cost of Hedging Railroads.**

The Leavenworth, Lawrence & Galveston Railroad Company offers to the farmers whose lands its road crosses to supply them with Osage orange plants to fence the line, and to pay them 35 cents per rod for setting, cultivating and trimming it when it has become a good fence. Some think this was not sufficient pay for the work. Mr. O. Chanute, the superintendent of this road, obtained the opinions of experienced hedge-growers on the matter. One of these, Mr. R. C. Tasker, of Lawrence, who has made growing plants and hedges his business for six years, gives the following figures:

| | |
|---|---|
| Preparing ground, two acres twice plowed | $8 |
| Setting plants, one man and boy two days | 5 |
| Cultivating two years | 15 |
| Total cost for three years | $28 |

Which is about 9 cents a rod. On any ordinary ground it need never cost more than 15 cents per rod, he says. Mr. Tasker having land on the line, backs his opinion by applying for a contract for eighty rods of hedge.

Mr. S. T. Kelsey, of Pomona, Kansas, writes:

"I have planted nearly fifty miles of hedge in Franklin county. Part of it is now well grown and turned out to protect the fields. I have kept an account of the cost of every item of expense, from the breaking of the prairie sod to the completion of the hedge so it will turn stock, and the cost to me is only from 20 to 25 cents per rod. This is where I am doing the work at home, on my own grounds. Being used to the work, I can do it somewhat cheaper than persons unused to hedging, but my judgment would be that 30 cents per rod, with plants furnished, would amply pay any persons for planting and growing a hedge where the work can all be done at home."

As the item of fencing is an important and a costly one on most Western railroads, hedging in this way is well worth trying wherever the plants will thrive. The Chicago & Alton Company has made some satisfactory experiments with Osage orange, and will soon have a large amount of it.

**The Hastings Bridge.**

The Minneapolis *Tribune* gives the following description of the bridge over the Mississippi at Hastings, Minn., built for the St. Paul & Chicago Railroad by the American Bridge Company of Chicago, and completed and tested with satisfactory results on the 9th inst.:

"The entire crossing (comprising the bridge proper and its approaches) is nearly three-fourths of a mile in length. The draw is 300 feet in length, the passage way for boats on either side of the pier on which the draw rests being 132 feet in the clear. The south end draw itself rests upon a pier built at the verge of the river on the Hastings shore. North of the draw are two spans of 150 feet each, and the span that rests upon the Washington County shore is 196 feet in length, making the entire length of the bridge proper 706 feet from shore to shore. The structure is one of Post's patent truss bridges, the material used in its construction being chiefly wrought iron. Its weight is 1,300 pounds per lineal foot, the draw being 1,600 pounds per lineal foot. The draw is operated by steam, the engine resting upon one end of the draw pier and the boiler upon the other. It is so perfectly adjusted that it only requires the strength of four men to turn it. It was built with a capacity of supporting a moving load of 1½ tons per lineal foot, without straining the iron beyond one-sixth of its ultimate strength. The whole structure and its approaches were built at a total cost to the company of $200,000.

**Selenitic Mortar.**

The *Journal of the Franklin Institute* says that Colonel Scott, R. E., has lately invented a process of producing mortar which is asserted to possess decided advantages.

The peculiarity of the process consists in mixing with the water used a small quantity of gypsum or plaster-of paris, or by adding green vitriol. The mixture is made in the pan of an ordinary mortar mill, the water and gypsum being first introduced, and then the lime. After grinding the lime for a short time, the sand, burnt clay, or other materials are added, and the whole mass is ground for ten minutes longer. By this process it is said a cement mortar can be made which sets quickly, and can be used for concrete, bricklayers' work, &c., cheaper than the ordinary material. Tests made with this mortar against Portland cement—under the same conditions—gave a result in favor of the former, the breaking weights of the two materials being 156 lbs. (mortar) and 58 lbs. (cement).

**New Fire-test for Petroleum.**

The following test for determining the burning point of petroleum oils without the use of fire is proposed by Dr. Van der Weyde:

"It is well known that the amount of combustible vapor evolved by a sample of these oils at a given temperature, depends, not upon its gravity, but upon its quality. Two oils (for example) of the same gravity need not necessarily evolve at 110 degs. Fahr. (the accepted standard temperature for the fire-test) the same amount of vapor; since one of them might be a mixture of oils lighter and heavier, the mean specific gravity of which might bring them to the same weight as the other. The amount of vapor given off by the two samples at the same temperature would, however, be very different, since the one adulterated with the light oils would evolve considerably more than the simple heavy oil of the other sample. The author has taken advantage of this fact, and simply measures the amount of vapor given off by the oil at the standard temperature, which is compared with computed or experimentally established quantities, and from this is able to announce the quality of the oil.

"A graduated glass-tube, open below, is filled with the oil, and immersed in a vessel of water of the temperature of 110 degs. Fahr., and the amount of vapor given off is read from the graduation. The avoidance of the danger from fire, and the small liability to error, afford strong recommendations for its use."

**Education of Mechanics.**

In his address at the recent opening of the new Mechanics' Institute at Bradford, England, Mr. W. E. Forster, M. P., remarked that when institutions of this kind were first established they were intended to give to mechanics scientific knowledge; but it was discovered that that was impossible, except in rare cases, because mechanics had no elementary teaching on which could be grounded scientific knowledge, and consequently these institutes were obliged to be turned very much into elementary schools and night schools, rather than into the teaching of science and higher literature, which we had hoped to give to our mechanics. A conviction, however, is now gaining ground that an essential portion of this elementary teaching consists of instruction in the rudiments of science, which would be of material advantage to none more than to the working classes.

**Steam on a Southern Canal.**

A Norfolk correspondent of the Raleigh *Sentinel* thus writes concerning a canal company: "I wish also to call your attention to this company's operations under the management of the Hon. Marshall Parks, a native citizen of Norfolk. This canal, with its improved river connections, is about 60 miles in length, and connects Norfolk with the Albemarle Sound. The fact in reference to this canal, which is particularly worthy of note, is this: nothing but steam has been used for propelling on this canal for the last fifteen years, and is said to be the only canal in the United States operated by steam. How is this that all other canals are so much behind this one here in the South?"

**A New System of Railroad Telegraphic Signals.**

A novel system of telegraphic signals has just been introduced by way of experiment at this end of the Lowell Railroad. At present only East Cambridge is connected with the Boston depot, but if the workings of the new system are found to be successful and satisfactory through the winter months, it may be adopted along the whole line. A box in the train house of the passenger depot on Causeway street is connected by wires with the office of the ticket master, who, when a train starts, by the pressure of a finger upon a little instrument, displays at an aperture in front of the box a red flag if in the day, or if it at night time the red sides of a lantern to view. When the engine reaches the rail directly in front of the station at East Cambridge the electric current is opened, and the red flag disappears or the lantern shows a white light. A bell is also rung at the same moment in the ticket office. If this system works well, and is adopted along the line generally, it may easily be so perfected that knowledge of the position of a train may be known at any station which it has just left, and thereby insure comparative safety to passengers.—*Boston Herald.*

**New Car-Coupler.**

John M. and Joab Enos, of Berrien, Mich., have received a patent dated November 26, 1871, of a novel self-acting car-coupler, which not only permits the use of the present link and pin, but is adapted to platforms of different heights. It has been in use on the freight cars of the Chicago & Michigan Lake Shore Railroad for four months with entire satisfaction. We are promised, by the inventor, drawings of it for publication in a few weeks.

**Description of an Electric Telegraph.**

A book with this title, which was first printed in 1823, has just been republished in London, by Sir Francis Ronalds. Before 1823 he sent intelligible messages through more than eight miles of wire insulated and suspended in the air. If the experiments which he then made had been only suggestions, this would have been remarkable, but as the scheme was put into actual practice, it ought to connect his name with the history of the electric telegraph.

**Locomotive Trial.**

The trial of two locomotives, one built by William Mason and the other by the Manchester Locomotive Company, was recently made on the Iowa Central Railroad. The trial consisted in drawing a train of twenty-four loaded freight cars up an ascending grade of about one mile in length, and which was steepest at the further end. The test of the trial was the time occupied from the start to reaching the top of the grade. Each engine weighed 29 tons, had 5 feet driving wheels and 16x24 inch cylinders. The engine built by Mr. Mason is reported as occupying 6¼ minutes in running to the top of the grade, and the Manchester engine 7½ minutes in running the same distance with the same load.

**Hoosac Tunnel.**

Concerning the negotiations for the purchase of this great work from the State of Massachusetts, the Boston correspondent of the New York *Times* says, under date of November 29:

"The Governor and Council had a private hearing this forenoon on the subject of the sale of the Hoosac Tunnel to New York parties. It is said that the offer originally came from Messrs. Vail & Robertson, of New York, who are supposed to represent Cornelius Vanderbilt. It is understood that the Governor and Council heard to-day the officers of the Fitchburg and the Vermont & Massachusetts railroads, who are the lessees of the Troy & Greenfield Railroad, on the expediency of the proposed sale. They are represented as decidedly opposed to the sale. The authority under which it is thought the sale might be arranged is a law providing for the completion of the Troy & Greenfield Railroad and the Hoosac Tunnel, which authorizes the Governor and Council to dispose of the interest of the Commonwealth in those enterprises. So great is the breeze raised by the press disclosures of the movement that it is probable the Governor will do nothing beyond to refer the subject to the next Legislature. The New York parties propose to give four million dollars for the enterprise just as it stands. There were to-day at the State House waiting to be heard against the scheme some of the most prominent railroad men in the State. All the roads are said to be violently opposed to the sale, and many of the best citizens of the State, and very likely.

**Novel Danger Signals.**

Men are now engaged in erecting novel danger signals at every bridge and tunnel on the Hudson River Railroad to warn brakemen, who are compelled at times to run along on the tops of trains, of their near approach to such dangerous places. A pole is erected by the side of the track, and an arm projects from it at the top, over the track. From this arm hangs a wire fringe, low enough to strike a brakeman on the front-piece of the cap or against the face if he is standing up as the train passes. This perceptibly notifies him that he is only one hundred feet from the bridge or tunnel, and must lie down at once. The blow inflicted by the fringe is momentarily a stinging one, but produces no evil results.—*Syracuse Standard.*

**The Prairie du Chien Bridge.**

Of this bridge, recently completed for the use of the Milwaukee & St. Paul Railway during the close of navigation, the Prairie du Chien *Union* says: "The bridge is one mile and three-fourths in length, and is supported by 1,033 huge pilings, averaging 30 feet in length. There were 9,590 feet of capping used, 12x12, 14 feet long, and 16,449 feet of stringers, 12x14, 24 feet long. It required the services of only 150 active men of brain and muscle, for ten days, to complete the bridge, and this was done without any apparent interruption in the transfer of passengers and freight."

**Iron Freight Cars.**

The Baltimore *American* says that the Baltimore & Ohio Railroad Company has experimented with iron freight cars, and, while finding them an improvement over the wooden car, has also discovered that in numerous instances certain kinds of freight were rendered useless by the sweating process to which iron cars are subjected. To obviate the sweating process a system of ventilation was resorted to, when it was found that if the goods were not covered with dust they were in great danger of being set on fire by sparks which found their way into the cars through the channels left open for ventilation. The company, however, is experimenting with iron cars, and will use every exertion to bring them into general use.

**The Nine Hours Movement.**

All the engineering firms in Birmingham and Wolverhampton (England) have adopted the nine-hour system. They all bind themselves to commence the fifty-four hours weekly on the 1st of January next; the men, on their part, agree to work over-time when required. The movement is making rapid progress in Europe, and many firms are conceding it, and the number who are doing so is rapidly increasing.

**Novel Material for Ballast.**

A correspondent of *Engineering*, writing from Germany, says:

"The residuum from soda manufactories forms an excellent ballast. It is the almost universal practice to manufacture sulphur out of soda waste. After being desulphurized, the remnant consists chiefly of sulphur and carbonate of lime. Employed as ballast this material keeps the sleepers perfectly dry and preserves the timber. Considerable experiments were conducted with it some time since, and with very marked results. Of course its application would be limited in consequence of the comparatively small quantity available."

**Warming Cars.**

The following is given as a successful method of warming cars, as practiced on German railroads. It should be remembered that cars in that country are frequently not warmed at all, and that what might be there a great improvement in the comfort of travelers, here would be considered insufferable:

"The fuel employed consists of a mixture of charcoal, nitrate of potash and starch. Charcoal was first used alone, in perforated iron boxes 2 feet long, 4½ inches wide, and 2¾ inches deep; but it was found that passengers generally suffered from violent headaches, and an

improvement was made on the method by substituting the mixture above mentioned for simple charcoal, and employing closed iron boxes, which are slipped under the seats—the boxes having double tops to prevent them from making the seats uncomfortably warm for those occupying them. The fuel, which is pressed into cakes four inches long, three inches wide and two inches thick, is placed in boxes and lighted, and the boxes are then put in their places and left to take care of themselves. An account of some experiments made with this method on one of the German railroads mentions one instance in which, on the line between Aix-la-Chapelle and Berlin, a compartment was comfortably and evenly heated by eight cakes of the fuel for sixteen hours, at the end of which time the boxes were opened and the fuel was found to be still red hot. The fuel is said to cost about $4 per cwt., and the expense of heating a compartment is less than two cents per hour."

## Bauschinger's Indicator Experiments on Locomotives.

[CONCLUDED FROM PAGE 404.]

### 4. *Water and Steam Consumption.*

We have already pointed out, in a former article, the marked discrepancy existing between the theoretical curve of expansion, as laid down according to the various laws, and the actual expansion curve drawn by the indicator; and we explained, at the time, that this phenomenon was mainly due to the heat which is received by the expanding steam from the cylinder. Before proceeding further, we shall now investigate this peculiar action of the steam during the period of expansion in greater detail. Suppose the steam to be in a perfectly dry and saturated state at the commencement of the expansion, we shall find, if we follow the actual expansion line, that by abstracting a certain quantity of heat from the cylinder, the contained steam has become super-heated; if we then apply the law of Mariotte-Gay-Lussac to the expanding steam in this super-heated state, the course of the actual expansion curve would lead to extraordinary high temperatures, in order that the existing pressures should be accounted for. As an example, we will take the diagram represented in fig. 23, on page 301, and assuming the steam to be quite dry and saturated at the commencement of expansion, marked *a* in the diagram, its temperature for the corresponding pressure at a point, *c*, would have to be not less than 482 deg. Fahr. The fallacy of this theory being evident, we must search for other arguments to account for the revelations of the indicator, and we are consequently led to conclude that the steam is, in reality, in a *wet* state at the commencement of the expansion; also, that a sufficient amount of heat can be obtained from the cylinder, so that, by the re-evaporation of the water combined with the steam, its pressure can be maintained at the height of the actual expansion line. Referring again to the diagram just mentioned, we will next suppose the steam to contain 20 per cent of water at the point of cut-off, and following its action it will now be found that at a point, marked *b* in the expansion curve, this amount of water has been completely dried or evaporated; from this point, therefore, the steam would, of course, pass into the superheated state, and applying again the perfect gas theory to the steam expanding in such a state, the result would represent, at a point marked *d* in the diagram, the enormous temperature of 422 degrees Fahr. The acceptance of 20 per cent. of water is consequently insufficient, and in the particular case of diagram, fig. 23 on page 301, the water contained in the steam must have been much more than this quantity; in fact, to account for the additional work performed, as shown by the elevation of the actual expansion curve until a point, *e*, is reached (marking the opening of the exhaust valve), the steam must have contained at least 35 per cent. of water at the commencement of the expansion.

But the question of the precise quantity of water contained in the steam is not so easily determined, and no direct means of ascertaining the nature of the steam in this respect being at the disposal of the experimenters, Professor Bauschinger proceeded in the following way: The theory of mechanical heat gives a formula by means of which the specific volume of saturated steam can be measured from its corresponding pressure; by the aid of this formula—the correctness of which has since been verified by the experiments conducted by Fairbairn and Tate—Zeuner computed his tables concerning the properties of saturated steam. To measure now the amount of steam expended in producing a certain power, we should first mark in the diagrams, obtained during a run, all the leading points of the steam distribution, as commencement of admission, expansion, release and compression, and then ascertain the quantities of steam contained in the cylinder at these respective points, presupposing, however, that the steam was in a dry and saturated state. In most cases, the exact point of admission cannot be decided with sufficient accuracy; but as regards the other elements, it will be found that in the case of diagram, fig. 23, on page 301, the cylinders contained per revolution 0.527, 0.890 and 0.334 lb. of steam at the commencement of expansion, release and compression respectively; in the next diagram, fig. 24, on the same page, the relative contents in the cylinders will be 1.333, 1.520 and 0.246 lb. of steam per revolution. As regards the first two of these figures, viz., the quantities of steam contained in the cylinder at the commencement of expansion and release respectively, they should be the same, as the weight of the steam undergoes no change during the period of expansion; but owing to the process of condensation and re-evaporation which has taken place in the cylinder, the indicator diagram nearly always shows a greater quantity of steam exhausted than received. Thus, in the case of diagram, fig. 23, on page 301, the quantity of water evaporated during expansion will be obtained by subtracting the weight of the steam at the commencement of the expansion from that of the steam at commencement of release, assuming that the steam was at this latter point in a perfectly dry state; consequently, 0.890—0.527—0.363 lb., equal to 40 per cent. of the weight of the total amount of steam present in the cylinder at the commencement of the release. Next, in order to obtain the amount of steam used per revolution of driving wheel, the quantity of steam retained in the cylinder when the escape is cut off, and which is therefore compressed into the clearance spaces, should be deducted from either the quantity of steam contained at the beginning of expansion or that contained at the beginning of release; thus, in the above example, we shall find 0.527—0.334—0.193 lb., and, in the second case, 0.890—0.334—0.556 lb.

By calculating in this manner the steam consumption during an entire run, and by measuring at the same time the quantity of water used, the difference existing between these amounts will express the quantity of water contained in the steam, affording thus a close approximation as regards the real state of the steam immediately before the commencement of the periods of expansion and release. These calculations were made by Professor Bauschinger on each run; the method followed during these computations being similar to that employed for ascertaining the total amount of work developed on a run, as described by us on page 404. We give in subjoined Table No. VIII., these data, some of which, we should mention, appertain to the same indicator curves as already put together on page 239, while the Table No. IX., on the next page, shows the work developed by 1 lb. of steam as obtained in the different engines and for various degrees of expansion.

It will be seen, by glancing over columns *O* and *P*, of table No. VIII., that for similar conditions of working the respective figures differ little from each other; but, on the other hand, the amount of "throttling" given in columns *D* and *E*, will materially affect these figures. We have already shown why the figures contained in column *M* give a nearer approximation to the true consumption of steam than those of column *L*, and consequently the results in column *P* should be taken as a criterion by which to judge the action per pound of steam; it will be noticed that, in the case of both engines, the figures given in this column are diminished as the amount of wire-drawing or throttling increases.

In computing, on the other hand, the results given in table No. IX., only such experiments have been selected during which the regulator was kept practically full open, and in order to establish the comparative action of the steam in the different engines, the average of the figures corresponding to the last two columns of the foregoing table was multiplied by the constant factor 4 + piston area + stroke, the results thus expressing the amount of work done by 1 lb. of steam. These results, it will be observed, furnish some curious and interesting data regarding the action of the steam. Thus referring to the first four engines with the shifting link motion, it appears that the advantage of the expansive working are materially impaired by the moist nature of the expanding steam. The same phenomenon is also demonstrated by the relations of columns 12 and 13 with column 20 of Table No. VII., published on page 404. Finally, by comparing the results recorded in Table No. IX. for the different engines of the shifting link and of the double valve motion class respectively, the duty given off per pound of steam is seen to be considerably higher in the former engines, a fact which corroborates the statements already made concerning the relative merits of the two systems of valve motion, and according to Professor Bauschinger, the balance in favor of the shifting link motion appears to be due essentially to the action of compression. It should be remembered, however, that the results computed in Table No. IX. are based on the supposition that the steam is in a dry state; on the other hand, it is evident that the nature of the steam is greatly influenced by the degree of expansion, so that, in this respect, experiments on engines fitted with variable expansion gear generally can merely furnish approximate results.

TABLE VIII.

| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Pressure in pounds per square inch.* | | | | | *Steam contained in cylinder in pounds per revolution.* | | | *Consumption of steam per revolution.* | | | | |
| Class of engine..... | Period of admission in per cent. of stroke..... | Number of revolutions of driving wheel per minute..... | In boiler..... | Maximum during admission..... | At beginning of expansion..... | At beginning of release..... | At beginning of compression..... | Before expansion..... | Before release..... | Before compression..... | Calculated from columns I and K..... | Calculated from columns J and K..... | Mean effective pressure in pounds per square inch..... | Column N ÷ column L..... | Column N ÷ column M..... |
| | per ct. | rev. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | | |
| | | 142 | 116 | 115 | 102 | 34 | 9.5 | 0.58 | 1.02 | 0.38 | 0.20 | 0.63 | 37 | 185 | 59 |
| | | 125 | 114 | 113 | 103 | 33 | 9 | 0.56 | 0.99 | 0.38 | 0.20 | 0.61 | 38 | 182 | 62 |
| | | 147 | 113 | 100 | 89 | 28 | 5.5 | 0.52 | 0.89 | 0.32 | 0.20 | 0.57 | 35 | 175 | 61 |
| | | 124 | 98 | 98 | 90 | 28 | 5.5 | 0.53 | 0.89 | 0.33 | 0.19 | 0.56 | 36 | 187 | 64 |
| | | 119 | 94 | 90 | 84 | 26 | 6 | 0.50 | 0.85 | 0.33 | 0.16 | 0.52 | 30 | 179 | 58 |
| | | 124 | 117 | 113 | 103 | 34 | 10 | 0.59 | 0.99 | 0.39 | 0.19 | 0.59 | 36 | 187 | 61 |
| | | 136 | 106 | 88 | 76 | 23 | 5 | 0.46 | 0.78 | 0.30 | 0.15 | 0.47 | 27 | 174 | 58 |
| | | 132 | 111 | 84 | 70 | 21 | 5.5 | 0.43 | 0.72 | 0.33 | 0.10 | 0.39 | 21 | 202 | 55 |
| | | 120 | 85 | 32 | 73 | 21 | 3.5 | 0.45 | 0.74 | 0.28 | 0.16 | 0.45 | 27 | 166 | 60 |
| | | 140 | 83 | 80 | 73 | 23 | 4.5 | 0.45 | 0.74 | 0.31 | 0.14 | 0.43 | 26 | 184 | 60 |
| | | 184 | 105 | 74 | 65 | 18 | 3.5 | 0.40 | 0.67 | 0.29 | 0.11 | 0.37 | 23 | 209 | 62 |
| A..... | 16 | 117 | 111 | 61 | 54 | 14 | 2.5 | 0.35 | 0.57 | 0.28 | 0.07 | 0.29 | 18 | 328 | 62 |
| | | 147 | 88 | 50 | 43 | 9 | 3 | 0.29 | 0.50 | 0.28 | 0.01 | 0.21 | 10 | 333 | 50 |
| | | 115 | 114 | 36 | 30 | 4 | 2 | 0.23 | 0.40 | 0.27 | .... | 0.13 | 4 | .... | 31 |
| | | 120 | 107 | 107 | 98 | 33 | 5.5 | 0.56 | 0.98 | 0.32 | 0.24 | 0.66 | 43 | 178 | 65 |
| | | 149 | 72 | 59 | 49 | 14 | 3.5 | 0.33 | 0.60 | 0.29 | 0.03 | 0.30 | 16 | 457 | 53 |
| | | 144 | 71 | 38 | 33 | 6 | 3 | 0.25 | 0.44 | 0.28 | .... | 0.15 | 7 | .... | 47 |
| | | 146 | 92 | 57 | 51 | 12 | 4 | 0.34 | 0.57 | 0.30 | 0.04 | 0.27 | 14 | 350 | 52 |
| | | 139 | 90 | 78 | 70 | 21 | 5 | 0.43 | 0.75 | 0.31 | 0.11 | 0.43 | 24 | 209 | 56 |
| | | 137 | 73 | 72 | 65 | 17 | 3 | 0.41 | 0.66 | 0.28 | 0.13 | 0.37 | 24 | 195 | 65 |
| | | 133 | 80 | 66 | 59 | 16 | 3.5 | 0.38 | 0.65 | 0.30 | 0.08 | 0.35 | 20 | 235 | 57 |
| | | 129 | 85 | 80 | 76 | 25 | 4.5 | 0.45 | 0.81 | 0.31 | 0.13 | 0.50 | 24 | 201 | 56 |
| | | 126 | 93 | 89 | 82 | 25 | 6 | 0.49 | 0.82 | 0.33 | 0.15 | 0.49 | 31 | 197 | 63 |
| | | 122 | 73 | 70 | 65 | 20 | 5 | 0.41 | 0.72 | 0.31 | 0.09 | 0.40 | 23 | 250 | 57 |
| | | 148 | 86 | 86 | 81 | 10 | 4 | 0.34 | 0.53 | 0.03 | 0.30 | 0.50 | 30 | 98 | 60 |
| | | 121 | 80 | 77 | 73 | 9 | 2 | 0.31 | 0.51 | 0.03 | 0.28 | 0.48 | 28 | 99 | 58 |
| | | 83 | 77 | 73 | 71 | 10 | 3 | 0.31 | 0.53 | 0.03 | 0.27 | 0.50 | 28 | 100 | 55 |
| | | 173 | 78 | 70 | 67 | 7 | 3 | 0.29 | 0.47 | 0.03 | 0.26 | 0.44 | 25 | 95 | 57 |
| | | 172 | 78 | 66 | 64 | 6 | 3.5 | 0.28 | 0.45 | 0.03 | 0.25 | 0.42 | 23 | 91 | 55 |
| | | 109 | 86 | 80 | 74 | 10 | 2.5 | 0.32 | 0.50 | 0.03 | 0.28 | 0.51 | 32 | 111 | 62 |
| | | 197 | 62 | 55 | 50 | 4 | 3.5 | 0.23 | 0.42 | 0.03 | 0.20 | 0.38 | 16 | 80 | 41 |
| | | 169 | 66 | 21 | 19 | —6 | 0 | 0.12 | 0.21 | 0.02 | 0.10 | 0.18 | 2.5 | 24 | 13 |
| E..... | 12.6 | 167 | 85 | 80 | 78 | 10 | 4 | 0.33 | 0.51 | 0.03 | 0.29 | 0.48 | 29 | 101 | 60 |
| | | 155 | 57 | 49 | 47 | 2.5 | 2.5 | 0.22 | 0.37 | 0.03 | 0.19 | 0.34 | 16 | 82 | 47 |
| | | 144 | 81 | 72 | 69 | 9 | 3.5 | 0.30 | 0.50 | 0.03 | 0.26 | 0.47 | 26 | 97 | 55 |
| | | 132 | 83 | 68 | 65 | 8 | 4.5 | 0.28 | 0.48 | 0.03 | 0.25 | 0.45 | 21 | 80 | 47 |
| | | 179 | 58 | 44 | 41 | 3 | 2 | 0.20 | 0.37 | 0.03 | 0.17 | 0.34 | 15 | 85 | 44 |
| | | 169 | 70 | 11 | 9 | —8 | 0 | 0.09 | 0.16 | 0.03 | 0.06 | 0.13 | —2.5 | .... | .... |
| | | 159 | 71 | 24 | 22 | —5 | 0 | 0.14 | 0.21 | 0.02 | 0.11 | 0.18 | 5 | 44 | 27 |
| | | 156 | 69 | 16 | 14 | —7 | 0 | 0.11 | 0.18 | 0.02 | 0.08 | 0.15 | 1 | 12 | 6 |
| | | 204 | 58 | 46 | 43 | 2.5 | 2.5 | 0.21 | 0.37 | 0.03 | 0.17 | 0.34 | 13 | 73 | 38 |

TABLE IX.

| Class of Engine... | Period of admission. | | | Duty performed per pound of steam. | |
|---|---|---|---|---|---|
| | Number of notch. | Apparent admission in per cent. of stroke. | Actual admission in per cent. of stroke. | According to column (O) of Table VIII. | According to column (P) of Table VIII. |
| | | per cent. | per cent. | foot-pounds. | foot-pounds. |
| A | 1 | 15 | 20 | 287,000 | 89,000 |
| | 2 | 22 | 27 | 164,000 | 92,000 |
| | 3 | 30 | 34 | 136,000 | 88,000 |
| | 4 | 43 | 46 | 98,000 | 83,000 |
| | 5 | 51 | 54 | 88,000 | 79,000 |
| | 6 | 57 | 59 | 82,000 | 74,000 |
| | 7 | 62 | 64 | 79,000 | 75,000 |
| | 8 | 74 | 75 | 65,000 | 66,000 |
| B | 1 | 19 | 24 | 198,000 | 97,000 |
| | 2 | 26 | 30 | 136,000 | 92,000 |
| | 3 | 34 | 38 | 110,000 | 86,000 |
| | 4 | 44 | 47 | 98,000 | 83,000 |
| | 5 | 62 | 64 | 77,000 | 71,000 |
| | 8 | 78 | 79 | 56,000 | 56,000 |
| C | 3 | 36 | 40 | 108,000 | 86,000 |
| | 4 | 42 | 46 | 99,000 | 83,000 |
| | 5 | 49 | 52 | 90,000 | 79,000 |
| | 6 | 55 | 58 | 83,000 | 79,000 |
| D | 2 | 20 | 25 | 182,000 | 103,000 |
| | 3 | 28 | 32 | 141,000 | 95,000 |
| | 7 | 60 | 62 | 68,000 | 64,000 |
| E | 1 | 12 | 18 | 112,000 | 63,000 |
| | 2 | 15 | 21 | 114,000 | 63,000 |
| | 3 | 21 | 26 | 95,000 | 60,000 |
| | 4 | 29 | 34 | 92,000 | 68,000 |
| | 8 | 96 | 98 | 33,000 | 30,000 |
| F | 1 | 23 | 27 | 86,000 | 62,000 |
| | 2 | 28 | 33 | 77,000 | 58,000 |
| | 3 | 36 | 40 | 74,000 | 61,000 |
| | 4 | 47 | 51 | 70,000 | 66,000 |
| | 8 | 85 | 86 | 53,000 | 49,000 |
| G | 1 | 30 | 34 | 90,000 | 70,000 |
| | 2 | 39 | 42 | 82,000 | 68,000 |
| | 3 | 57 | 60 | 68,000 | 65,000 |
| | 4 | 97 | 98 | 42,000 | 42,000 |
| H | 1, II | 21 | 27 | 107,000 | 78,000 |
| | 2, " | 30 | 36 | 99,000 | 79,000 |
| | 3, " | 38 | 43 | 86,000 | 78,000 |
| | 4, " | 43 | 48 | 79,000 | 74,000 |
| | 5, I | 45 | 50 | 72,000 | 65,000 |
| | 6, II | 48 | 52 | 73,000 | 68,000 |
| | 8, I | 75 | 77 | 56,000 | 58,000 |
| | 8, II | 87 | 78 | 49,000 | 50,000 |

In conclusion, it will be seen that in the case of locomotive engines, the circumstances which have to be contended against in conducting reliable indicator experiments are of a very difficult nature. Our abstract, which we have now completed from the extensive reports of Professor Bauschinger and Herr Zorn, will give some idea of the labor that has been bestowed by the experimenters upon their work; while, on the other hand, the results of these experiments show fully the amount of useful information afforded by the revelations of the indicator.—*Engineering.*